Gould 610/620 Series Digital Storage Oscilloscopes Operator Manual

GOULD

MP MASTER
MA34618

Gould 610/620 Series
Digital Storage Oscilloscopes
Operator Manual

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Introduction

About the 610 and 620

The Gould 610 and 620 instruments are Digital Storage Oscilloscopes. They include all the features expected of an advanced modern oscilloscope designed for the professional engineer, whilst retaining the user-friendliness essential for those learning to use such an instrument for the first time.

Obtaining a trace is especially simple - just connect the signal and press the Auto Setup button - the instrument does the rest. Having obtained a trace, readily accessible datum lines and a cursor make it easy to take automatic timing and voltage measurements directly from the display.

More advanced features include a dual timebase complete with separate trigger facilities and the pre-trigger display function which allows the signal *prior* to the trigger point to be captured and displayed.

Sixteen complete traces can be stored in the battery backed memories for future use and can be recalled to any of the eight trace displays via the Save Trace and Recall Trace menus respectively. The battery back-up for the memories ensures that stored traces will be retained even when the instrument is turned off.

Various options are available for the 610 and 620 instruments: these include GPIB and RS423 interface pods and internal color or thermal plotters.

About this Manual

This manual contains information on the operational features of the 610 and 620 Digital Storage Oscilloscopes. For servicing information refer to the Servicing Manual.

Throughout this manual references to, the instrument or DSO, refer to both the 610 and the 620. Section 1.1, Safety and Power Requirements, must be read and note taken of its contents before using the oscilloscope.

The manual is split into various sections that allow both the novice and advanced user to find basic and more advanced operating information.

Section 1 contains basic information on standard operating features using the front panel controls, section 2 details more advanced features available from the front panel controls and section 3 explains the further features that are accessed by using the menu system.

Section 4 provides instructions for basic performance checking, section 5 has details of options that are available for the instruments and includes details of the GPIB and RS423 commands. Section 6 is a summary of all the front panel controls.

Numbers shown in brackets in the text refer to the controls shown on the fold out front panel picture in appendix 7.

1.1 Safety and Power Requirements

1.1.1 International Safety Warning
(as required for I.E.C. 1010)

This instrument has been designed and tested in accordance with IEC publication 1010, and has been supplied in a safe condition.

This manual contains information and warnings that must be observed to keep the instrument in a safe condition. The instrument should not be switched on if it is damaged and it should not be used under wet conditions.

For the correct and safe use of this instrument it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

Whenever it is likely that safety-protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation. Qualified maintenance or repair personnel should be informed. Safety-protection is likely to be impaired if, for, example the instrument shows visible damage or fails to operate normally.

1.1.2 Grounding

The instrument must be operated with a protective ground connected via the yellow/green conductor of the supply cable.

This is connected to the instrument before the line and neutral connections when the supply plug is inserted into the socket on the back of the instrument. If the final connection to the supply is made elsewhere, ensure that the ground connection is made before line and neutral.

WARNING: Any interruption of the protective ground conductor inside or outside the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.

Signal connections to the instrument should be connected after the ground connection is made and disconnected before the ground connection is removed, i.e the supply lead must be connected whenever signal leads are connected.

1.1.3 Live Parts

The instrument must not be operated with covers removed. The covers protect the user from live parts and they should be removed only by suitably qualified personnel for maintenance and repair purposes.

WARNING: Removing the covers may expose voltages in excess of 10kV at the side of the display tube; these may be present for up to one minute after the instrument has been disconnected from the power source.

1.1.4 Ventilation and Dust

The instrument relies on forced air cooling via a fan and ventilation slots. Adequate ventilation can usually be achieved by leaving a 75mm (3" gap) around the instrument. Care should be taken to avoid restricting the airflow to the fan at the rear of the instrument.

The instrument should not be operated in dusty environments.

The rear fan filter should be regularly cleaned to prevent a build up of dust restricting the airflow. To remove the filter, ensure that the instrument is turned off and unclip the retaining cover and filter assembly from the rear of the instrument. The filter can then either be cleaned, by blowing through with compressed air, or replaced with a new one, part number 459577.

If the CRT filter requires cleaning it can be easily removed by unclipping it from the front of the instrument.

1.1.5 Operating Temperatures

The instrument is designed to be operated in an environment having an ambient temperature of between 0 and 50 degrees C, and to operate with full accuracy between 15 and 35 degrees C.

Note: *Direct sunlight, radiators and other heat sources should be taken into account when assessing the ambient temperature.*

The instrument may occasionally be subjected to temperatures between 0 and -10°C without degradation of its safety.

1.1.6 Power and Frequency Requirements

The instrument uses less than 230VA and operates from line voltages of 90V to 132V, and 180V to 264V, at 45 to 400Hz. Under the extreme conditions of 90V and 45Hz, the instrument will still operate correctly even if there is a half cycle dropout in the line supply.

The power connection is via a standard IEC, CEE 22 connector. Before connecting the instrument to the supply, ensure that the rear panel AC supply voltage selector is set to the appropriate voltage, either 115V or 230V.

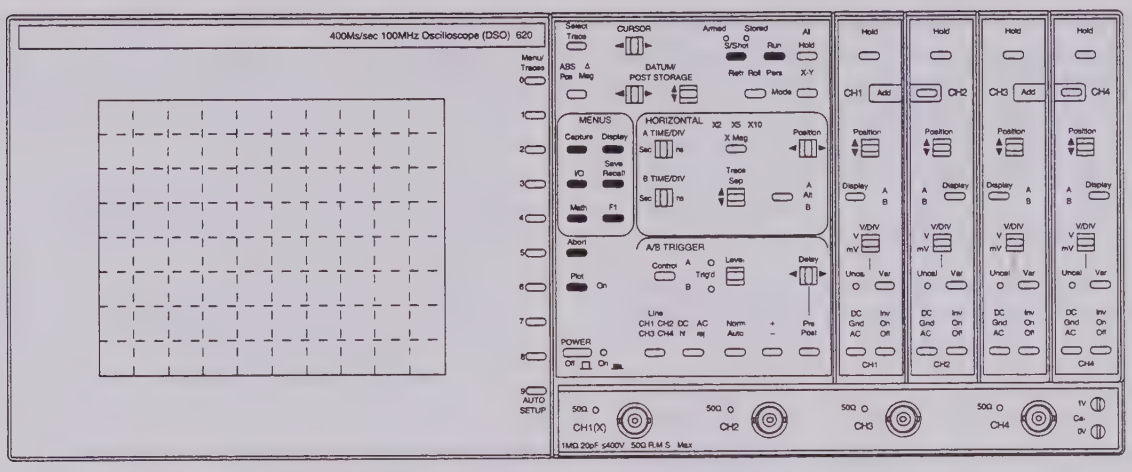


Figure 1.2a Single Function Buttons

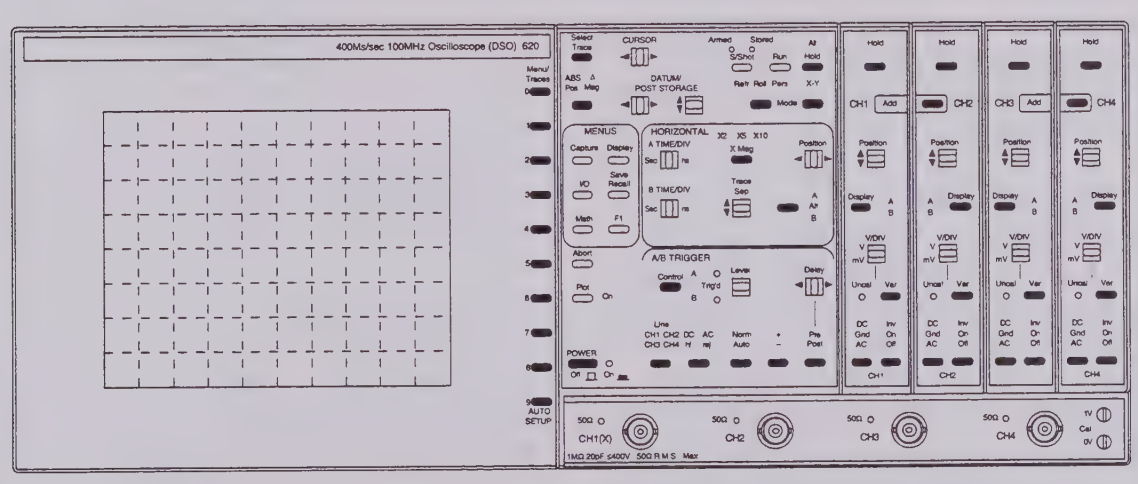


Figure 1.2b The Toggles

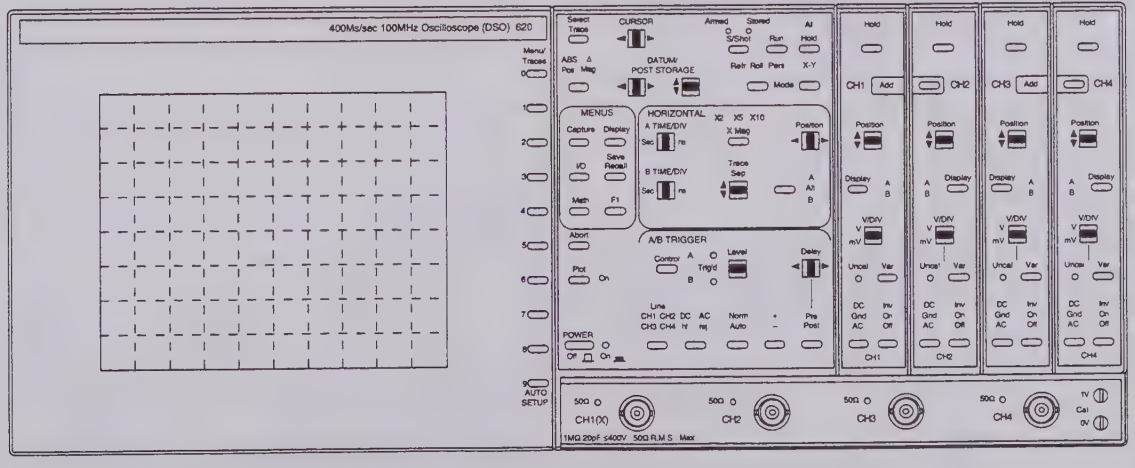


Figure 1.2c The Paddles

Access to the voltage selector can only be made if the AC supply connector is removed, and is by hinging open the panel connector from its top edge. The selector barrel can then be moved to the required setting. This same operation provides access to the AC supply fuse, which must be changed to suit the supply voltage as shown in table 1.1.7.

1.1.7 Fuse Requirements

The fuse arrangement shown in table 1.1.7 must be followed, and additionally in the UK, a 3A fuse should be fitted in the line supply plug.

Supply Voltage	Slow Blow Fuse Rating IEC (UL/CSA)	Gould Part No	Suggested types. Manufacturer/ Type No.
230V	2A (2.5A)	457455	Beswick/TDC488, Littlefuse/239, Schurter/FSP
115V	3A (4A)	457456	Beswick/TDC488, Littlefuse/239, Schurter/FSP

Table 1.1.7 Fuse ratings

1.2 Using the Buttons

Apart from the main power on off latching switch, there are three types of buttons on the instrument. The first type usually have only one function: when pressed, that one function will be activated e.g. **Capture** (4). See figure 1.2a.

The second type are toggles: each press of the button either switches something on or off e.g. **Add** (24), or selects the next item in a sequence e.g. **Off/On/Inv** (33). See figure 1.2b.

The third type are pressure sensitive: the effect caused depends upon how hard the paddle is pressed. For example a gentle push of a **Position** paddle (25), up or down, will move the trace slowly. If the paddle is pushed further, the trace will move more quickly. See figure 1.2c. These controls are known as PHGF (Push Harder Go Faster).

1.3 Start-Up Display

When first switched on with the **POWER** button (51), the instrument will go through its automatic self-calibration routine (if it is due) and then display information similar to that shown in Figure 1.3.

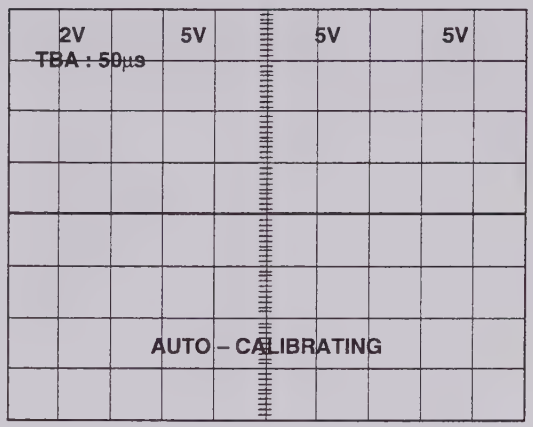


Figure 1.3 Start-Up Display

The trace is visible across the center of the screen. At the top will be the sensitivities of the input channels and the timebase speed. If any channel is inactive, information for that channel will not be displayed. If the unit has previously been used, the trace may not be visible as the instrument will remember and return to the previous setup.

Users with no previous experience of a DSO will find that the DSO responds like a conventional Real Time Oscilloscope while it is repetitively triggered, but in the absence of further valid triggers, it retains the last trace for continuous dispiay.

1.4 Obtaining a Trace

Whenever the DSO is switched on, the control settings at power down will be used. These may not suit the current input signals. The instrument can be set to suit new signals either manually or, Automatically using the Auto Setup feature.

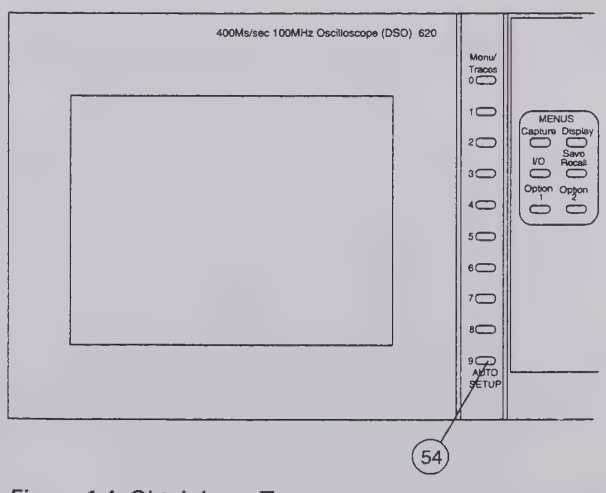


Figure 1.4 Obtaining a Trace

1.4.1 AUTO SETUP

To display an input signal, connect it via any of the channel input sockets (34), (37), (42) or (48) and press **AUTO SETUP** (53).

CAUTION: Signals connected to the input socket should not be more than ± 400V peak. Larger signals could cause damage to the internal circuitry.

Assuming a regular signal has been applied, say a 2kHz sine-wave with an amplitude of perhaps 5V peak to peak, auto setup will set the instrument to show the sinewave on the display. An example is shown in figure 1.4.1.

If any of the display intensities have been set to zero, Autosetup will restore them to minimum brightness. If the display is still too dim, maybe due to high ambient light conditions, see section 3.10.

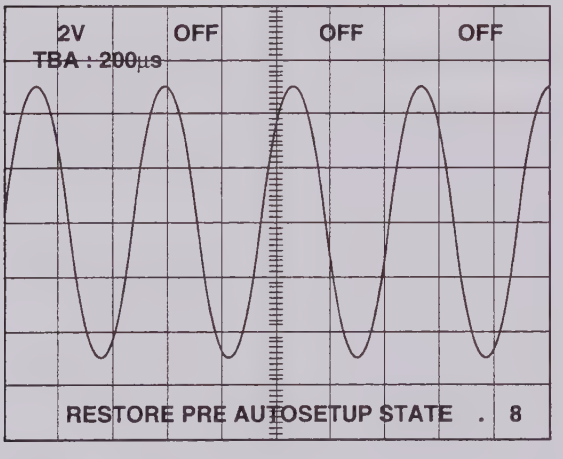


Figure 1.4 .1 An AUTO SETUP Display

AUTO SETUP will attempt to arrange the display so that two to five complete cycles appear, with the amplitude set so that the height of the trace is between two and five screen divisions.

The lowest channel number with a valid input signal will take priority for triggering and timebase selection.

Some input signals are unsuitable for use with the Autosetup routines, see section 1.8.6. If Autosetup is unable to set the instrument to suit the input signal it may display the message:

NO VALID INPUT

This message tells the user that the input signal is not repetitive, has a frequency which would require a slower timebase outside the Autosetup range, has too large an amplitude or is not suitable for any other reason.

Immediately following an Auto setup, the message 'RESTORE PRE-AUTOSETUP STATE' is displayed alongside numeric button **8**. Pressing button **8** while this message is displayed returns the instrument to its state immediately prior to the auto setup. Once any other button has been pressed the message is removed and the ability to return to the previous state is lost. This feature can be used to allow the user to recover from an accidental press.of AUTO SETUP.

Auto Setup will not alter any channel input impedance settings; 50Ω or 1MΩ, the trigger slope or Bandwidth Limit settings.

1.4.2 Manually Obtaining a Trace

This section describes how to obtain a trace without using **AUTO SETUP**.

Later sections of the manual may need to be consulted as not all of the operating features have yet been described.

1. When switched on, the instrument will go through its power-up sequence, checking the internal calibration if required.
2. Decide to which channel the input signal is to be applied. - CH1, CH2 or on the 4 channel instrument CH1, CH2, CH3 or CH4.

CAUTION: Signals connected to the input socket should not be more than ± 400V peak. Larger signals could cause damage to the internal circuitry.

3. Ensure that the chosen channel is active by setting the **Off/On/Inv** button (32) for that channel to On.
4. Set the **AC/Gnd/DC** button (33) for the chosen channel to Gnd.
5. If necessary, turn that channel's **Uncal** light out by pressing **Var** once (31).
6. Ensure that both **Trace Hold** (23) and **Hold All** (18) are off.
7. If necessary, turn the channel Add mode off (24) or (26)
8. Set the chosen channel's **Display** button to A (28).
9. Make sure that horizontal mag is not selected (21).
10. Set the sweep button (27) to A.
11. Adjust the **TIME/DIV A** paddle (13) to give a timebase of 100ms.
12. Set the display mode (18) to **Refr**.

13. Set the trigger control (47) to A and the trigger **Auto/ Norm** (43) to Auto.
14. Use the trigger source button (46) to select the required source for the trigger signals.
15. Set the trigger coupling with button (45). and ensure that trigger delays are set to zero using paddle (38)
16. Select **Run** (17).
17. If necessary, adjust the position of the trace using the **Position** buttons (22) and (25).
18. Apply the signal through a BNC connector to the chosen channel's input socket. (34), (37), (42) or (48).
19. Set the **AC/Gnd/DC** button (32) to either AC or DC as appropriate.
20. Adjust the gain of the chosen channel using the **V/DIV** paddle (29).
21. Adjust the timebase setting using the **TIME/DIV A** paddle (13).
22. If the display is unstable, adjust the trigger **Level** paddle (39) for a stable trigger, indicated by the Trig'd light (44)

1.5 Channel Controls

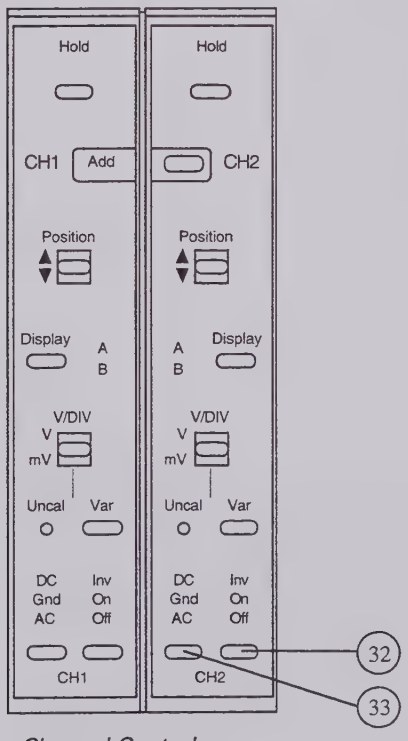


Figure 1.5 Channel Controls

1.5.1 Channel Selection (Off/On/Inv) (32)

A channel may be switched on or off with its **Off/On/Inv** button. If the channel is on, its trace can be displayed in either normal or inverted mode.

Off The channel is removed from the display, although it continues to be acquired and can also be used as a trigger source.

On The trace is a true representation of the input signal, or that channel is displaying a reference trace.

Inv The input signal is inverted before being displayed. If there is any DC component in the signal this will also be inverted and could cause the trace to disappear off the screen. Such an unwanted DC component can be removed by selecting AC coupling. Any vertical shift applied to the trace is not inverted. The trigger level and slope are unchanged.

1.5.2 Coupling (AC/Gnd/DC) (33)

These buttons control the type of coupling between the input signal and the instrument. DC is the most generally applicable, and **AUTO SETUP** will normally set this control to DC where possible.

The channel input impedance is normally 1MΩ in parallel with a capacitance of 18pF unless it has been set to 50Ω using the menu system. See section 3.2.2.

AC This is used to remove any DC component from input signals. Suitable input signals - i.e. the bandwidth - are from 4Hz to 100MHz.

Gnd The input signal is internally disconnected from the inputs and the input amplifier grounded. A 0V reference signal is displayed.

DC The input signal is directly coupled to the instrument so that all frequency components of the input signal will be displayed. The bandwidth will be from DC to 100MHz.

1.6 Horizontal Adjustments

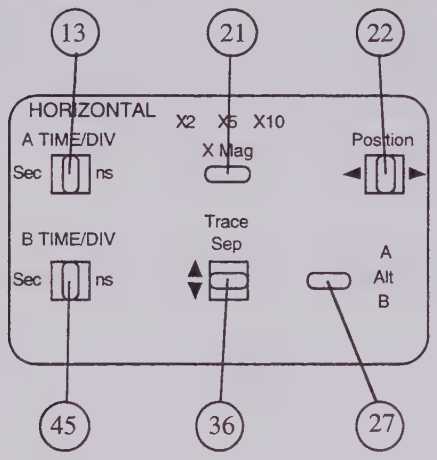


Figure 1.6 Horizontal Controls

There are two timebases in the DSO which can be used singly or alternately. They are controlled by the A and B TIME/DIV paddles.

For each channel pair (1 & 2 and 3 & 4), there is a third trace available. Each of the three traces can display either the A or B timbases for a channel. To display the B trace of a particular channel, press that channel's Display Button (28) so that A and B or just B is illuminated. This feature allows any three of the four possible traces for a channel pair (i.e. 1A, 1B, 2A & 2B) to be displayed at the same time.

The two timebases can be independently set but the B timebase must always be equal to or faster than the A timebase. If an attempt is made to violate this rule, the timebases will be forced to change ranges.

To obtain the different timebase modes, use the A Alt B key (27) to select A only, A & B alternately, or B only.

A — A only. Each channel will acquire a single trace on the A timebase setting. Only channels which are on will be displayed.

A alt B — A and B alternately (dual timebase mode). Each channel will acquire two traces: one on the A timebase setting alternating rapidly with one on the B timebase setting. Only channels which are on will be displayed.

B — B Only. Each channel will acquire traces on the B timebase setting. Only channels which are on will be displayed.

In dual timebase mode, both traces will be acquired from the same input channel so they will appear superimposed on the display. To separate the A and B timebase traces, use the Trace Sep paddle (36) as described in section 1.7.5.

1.6.1 TIME/DIVISION

Paddles (13) & (44) control the A and B sweep rates of the traces. Pushing the paddle towards 'ns' decreases the time/div, and towards 'Sec' increases the time/div. The timebases can be varied from 20ns/div to 50s/div. The 100ns, 50ns & 20ns ranges are always Equivalent Time Sampling (ETS) ranges. When an ETS time base is selected, the $^{ET}_{S}$ symbol appears at the right-hand side of the trace display

The instrument takes 501 samples per horizontal sweep: therefore there are 50 samples per division. The time between samples can be obtained by dividing the time per division by 50.

With a timebase of say 500ns/div, each horizontal screen division represents a 500ns section of a signal, consisting of 50 samples per division with a time between samples of 10ns i.e. a sample rate of 100MHz. The timebase selected is shown near the top of the display - e.g. TBA: 500ns.

Equivalent Time Sampling

The three fastest ranges are always produced by equivalent time sampling. This is a technique whereby a complete trace is built up by sampling a number of sequential acquisitions at various times relative to the trigger point. Clearly for this scheme to produce meaningful traces the input signal must be repetitive and have a stable trigger.

The number of acquisitions required to build up a trace is variable, but in general the faster timebases require more captures.

The fastest timebase, 20ns/div, is equivalent to a sampling rate of 2.5GHz, giving 25 samples per cycle on a 100MHz input signal.

The use of ETS allows captures with pre-trigger see section 1.9.1.

Under normal operating conditions, the timebase sequence is:

50s to 250ns	Transient capture
125ns	Transient or ETS (always ETS on 610)
100ns to 20ns	ETS repetitive sampling

ETS ranges can be used to capture and display repeating waveforms.

Transient capture ranges are used to capture and display single or non repetitive events as well as repeating waveforms.

Single channel mode (620 only)

When the instrument is displaying only one channel from each channel pair, an additional 125ns/div single shot transient range is available in place of the 125ns/div ETS range. Channels 1 & 2 are a pair as are 3 & 4. In this mode, the sample rate is 400MS/s.

1.6.2 Aliases

If a 2kHz signal is applied as mentioned earlier, when the timebase is set to 500ms/div, an interesting phenomenon may appear: an 'alias'.

An alias is a false image. The instrument is a digital oscilloscope and so takes frequent samples of the input signal in order to update the trace. If the signal frequency is higher than the sample frequency, one sample will be taken from a particular point on the wave form and the next sample may be taken from a point slightly further along on a subsequent cycle. It will then display the wave as being much slower than it really is. See figure 1.5.2. This effect will occur if the sample rate is less than twice the frequency of the input signal.

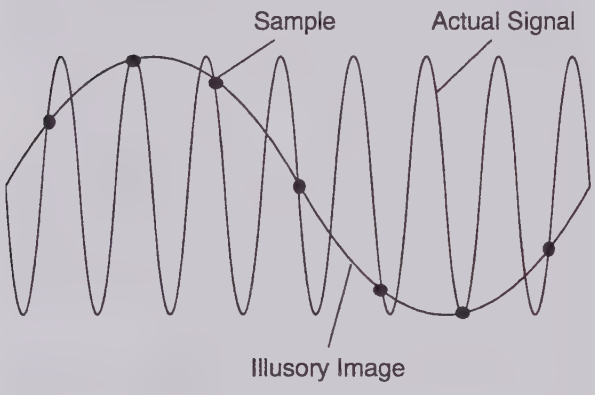


Figure 1.6.2 Alias Generation

There is a Max/Min glitch detection feature which can be used to detect aliases. With dot join on, this usually results in a filled-in wave envelope being seen on the screen, indicating a high frequency. See section 3.2.1

1.6.3 Position

The position paddle (22) moves all the traces to the left or right relative to the graticule.

The position of the cursor - section 2.5 - is fixed in relation to the traces so it will move with the applied shift. With some displays, such as X-Magnified traces - section 1.5.4 - , the cursor can be off the part of the trace displayed on the screen. To bring it back into view use the cursor paddle (10) or the position paddle (22).

1.6.4 Magnification

The **X-Mag** button (21) switches horizontal magnification through the sequence; Off, ×2, ×5, ×10, Off etc. When active, the selected expansion factor is applied to all displayed traces which then expand around the center of the screen. The indicators above the X Mag switch reflect the expansion factor selected.

If the message "Roll: will magnify when stored" appears, this means that although the display is showing a trace, the magnification cannot take place until the traces are stored or are all held.

If the cursor is on, selecting X-Mag may cause the cursor to move off the screen. It can be brought back into view using the cursor paddle (10) or the position paddle (22).

The instrument displays 50 dots (samples) per screen division, each displayed dot value being obtained from the 501 byte acquisition memory. At an expansion of ×10, there are, therefore, 5 acquired dots and 45 interpolated points per division displayed.

1.7 Vertical Adjustments

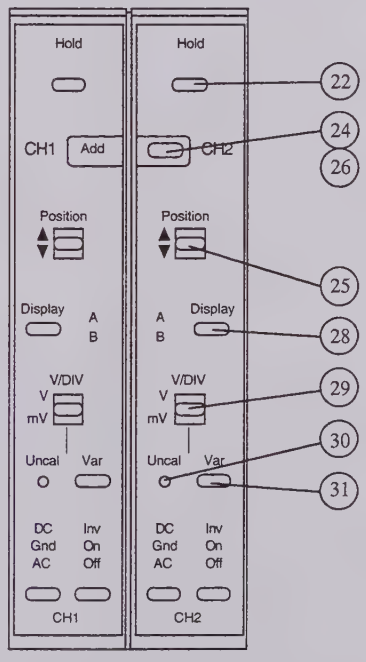


Figure 1.7 Vertical Controls

1.7.1 VOLTS/DIVISION

Paddle (28) adjusts the vertical sensitivity of the appropriate channel over discrete calibrated steps from 2mV to 5V per screen division in 1, 2, 5 steps. With probes other than x1 the probe tip ranges are shown in table 1.7. See also section 3.4.

Probe	Range		
×1	2mV	to	5V/div
×10	20mV	to	50V/div
×100	200mV	to	500V/div
×1000	2V	to	5000V/div

Table 1.7 Probe Tip Voltage Ranges

If **Var** mode is selected (31), then the **V/Div** paddle (29) varies the sensitivity of the signal input continuously. See section 1.7.3.

1.7.2 Position

The position paddles (25) move their respective traces up and down the display relative to the graticule.

If **Hold Trace,** or **Hold All** is on or a single shot capture has been made - see section 2.3 - and a trace subsequently shifted vertically, any part of the trace that was captured off the top or bottom of the screen will be shown by a horizontal line.

1.7.3 Variable/Uncalibrated

When the **Var** button (31) is set to 'Uncal', the coarse setting of the vertical attenuator is unchanged but a continuously variable attenuation is applied to the input signal in the range of 1 to 0.4. Thus with an initial setting of 1V, the actual sensitivity of the channel could be set by this control to anywhere between 1V and approximately 2.5V per division. The **V/DIV** paddle is used to vary the uncalibrated sensitivity.

In order to change the coarse setting of the V/Div, Uncal should be turned off. The range can then be changed using the V/DIV paddle (29). When the required coarse setting has been obtained, turn uncal back on again and the V/DIV paddle reverts to the variable sensitivity control.

When a channel Uncal is selected, the relevant uncal light (30) illuminates and the channel alphanumeric display changes from, for example =20mV to >20mV.

This feature can be used to calibrate an input signal to be a certain number of divisions e.g. the output from a sensor can be set to give a full scale trace for 100% input.

1.7.4 Add

The **Add** button (24)or (26) is used to display the sum, or if one channel is inverted, the difference of channels 1 and 2 or channels 3 & 4 in place of both the original traces.

When channels are added, a plus sign appears between the channel settings at the top of the display.

1.7.5 Trace Separation

To vertically separate A and B traces (see section 1.6), use The **Trace Sep** paddle (36). This will move all B traces relative to the A traces. To move only some of the B traces, place the cursor on the trace of interest and use post storage manipulation as described in section 2.3.5.

1.8 Trigger Control

The DSO has very comprehensive trigger facilities; those discussed here are available directly from the front panel. For the more advanced menu driven features see section 3.2.2 Acquisition/Trigger menu.

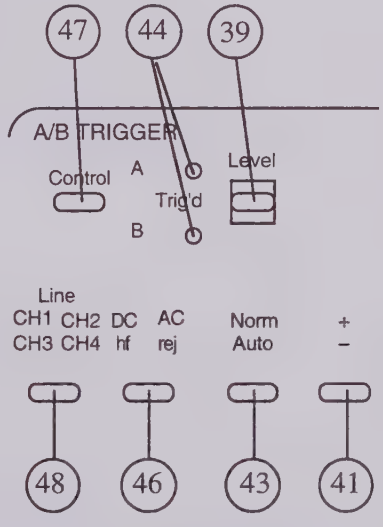


Figure 1.8 Trigger Controls

There are two trigger systems on the instrument: A and B. These two systems are independent of, and should not be confused with, the two horizontal timebases also called A and B. Each trigger system has its own source, coupling level, slope and delay settings.

Assuming that the horizontal system is **not** set to A ALT B, then an A Trigger starts ALL channel sweeps simultaneously and is a single event. The trigger controls determine when an event is recognized as a valid trigger. For further details of the trigger system, see the Trigger Setup Menu, section 3.6.

When the instrument receives a valid trigger, the relevant trigger light (44) briefly illuminates to indicate that the instrument is triggered (Trig'd). When a continuous sequence of valid triggers are received, the trigger lamp is continuously illuminated.

The trigger point is indicated by a 'T' at the bottom of the display.

When the instrument is turned off, the current trigger settings are retained and will be used on power up.

The choice between setting and adjusting the A or B trigger is made with the Trigger control button (47).

1.8.1 Selecting Trigger Source.

Button (48) determines the source from which the trigger circuit takes its input. Only one of the LEDs above the source buttons will be illuminated to indicate the trigger source. If line is selected, the trigger circuitry synchronizes to the line supply. External (EXT) is available on the 2 channel instrument only. The external trigger signal should be connected to the BNC connector labeled **EXT** on the front of the instrument.

1.8.2 Trigger coupling

Button (46) selects the coupling used for the trigger signal. Each press of the button moves the selection on one step through the sequence: AC, AC hf rej (high frequency reject), DC, DC hf rej, etc.

The high frequency reject option switches in a low pass filter set to 15kHz. Using this filter is helpful in stabilizing the trigger point on noisy input signals although it may reduce the accuracy of the trigger point indicator at high timebase rates.

1.8.3 Trigger level

The trigger level is set by the **LEVEL** paddle (39). This is a continuously variable control. An indication of the trigger level relative to the displayed trace is shown by two small horizontal bars one at each side of the display, or if the trigger level is off the screen, by two arrows indicating the relevant direction.

The trigger level bars give an approximation of the trigger level and should only be used as a guide to the trigger point. They are meaningful, with respect to the trace, unless the channel is DC coupled with the AC coupled triggering.

When the level control has been set so that valid trigger signals are being detected, the appropriate **Trig'd** lamp (44) lights up.

1.8.4 Trigger Slope

A trigger is generated when the selected source signal passes through the chosen trigger level. This crossing point can be on either a rising or falling edge. The rising edge is considered to be a positive slope and the falling edge a negative slope.

The trigger point can be selected to be on either the positive going edge (+) or the negative going edge (-) by selecting the required option using button (41). Each successive press of this button toggles between + and -.

1.8.5 Trigger mode (Auto/Norm)

The A trigger system can operate in two modes; Auto or Normal as selected by button (43). The B trigger system is always in Normal mode.

In Normal mode, display captures can only occur when a valid trigger signal has been received.

In Auto mode, if no valid trigger signal has been received within 40ms, the instrument will automatically produce its own trigger signal and initiate a capture. This ensures that the screen is constantly updated regardless of the input signal.

If valid triggers are received at a rate of approximately 25Hz or more, they will be used to start all captures and the instrument will not generate its own triggers.

1.8.6 External Trigger Input (2 channel only)

Trigger signals may be connected to the BNC socket labeled **EXT** on the front panel of the DSO. If **EXT** is then selected using button (48), these signals will be used as the trigger source.

When External trigger is selected, the trigger level is referenced to the center of the screen. i.e. if the coupling is DC then the trigger is referenced to ground and if the coupling is AC then the trigger is referenced to the center of the signal.

CAUTION: Signals connected to the EXT socket should not be more than ± 400V peak. Larger signals could cause damage to the internal circuitry.

1.9 Trigger delay

The acquired data position before, after and delayed from the trigger point is controlled using the PHGF delay paddle (38). See figure 1.9a. The amount of pre trigger or delay is shown at the bottom of the trace display when the delay paddle is pressed.

Either Pre or Post trigger delay is chosen using button (40). Any Pre or Post Trigger delay set are remembered by the instrument even when they are no longer selected. When either Pre or Post is re-selected, the previously remembered values will be restored.

Post trigger delay is the time between a trigger event being detected and the first sample acquired.

Note: *If the trace has been X shifted or magnified, the first point on the display is not necessarily the first sample point of the acquisition.*

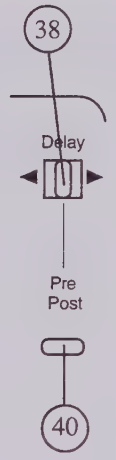


Fig 1.9a Trigger Delay Controls

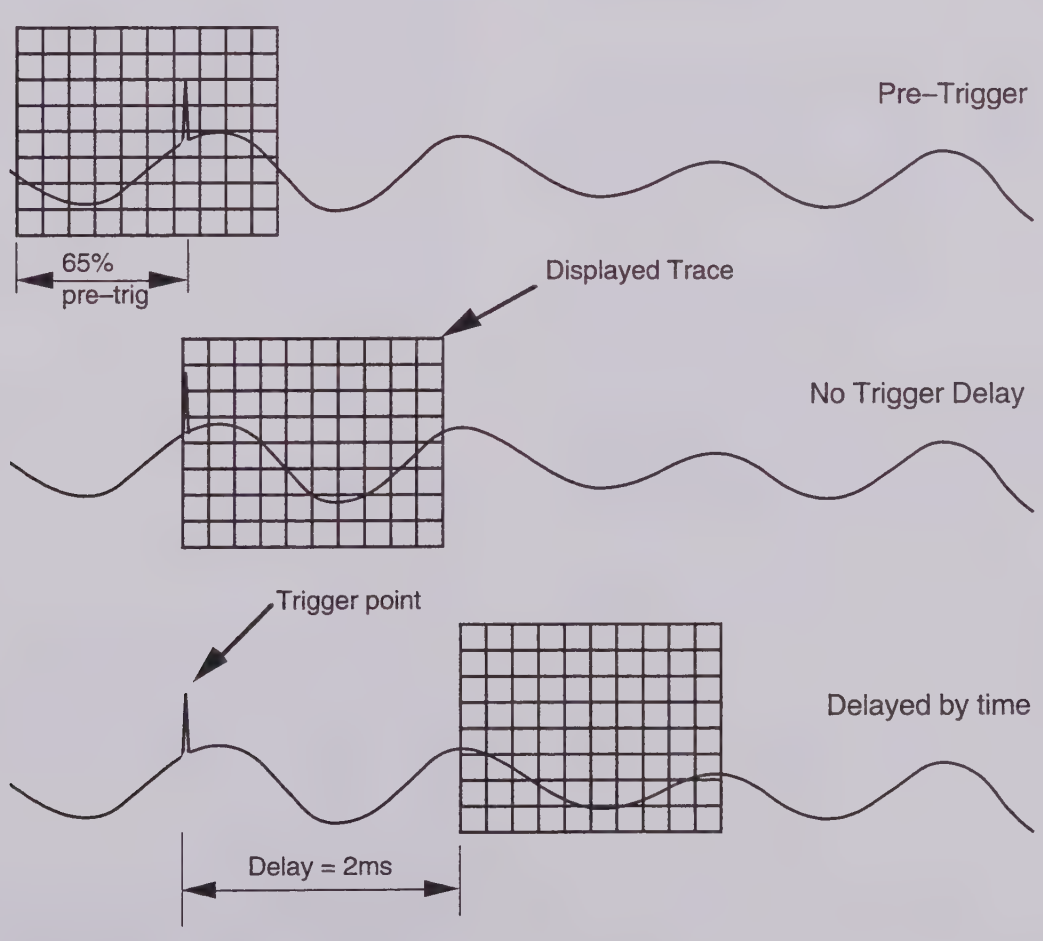


Fig 1.9b Trace capture with delay

1.9.1 Pre Trigger

Pre trigger is the ability to capture and display waveforms that occur partly or wholly prior to the trigger point.

Pre Trigger can be used either by pressing the Pre Post button (40) until the Pre lamp is lit or it can be selected in the Trigger Setup Menu - section 3.6.

Pre trigger is given as a percentage of screen width and can be set from 0 to 100% in 0.2% steps. While adjusting the percentage, the adjustment briefly pauses at 10% and 50%. With 0% pre trigger and no X-shift, the trigger point is at the left hand edge of the screen and 100% pre trigger puts the trigger point at the right hand edge of the screen.

The current amount is shown at the bottom of the screen while being adjusted with the delay paddle (38), and can also be viewed on the Status Menu (section 3.8) and also altered on the Trigger Setup Menu (section 3.6).

1.9.2 Delay by time

This is set by the Delay paddle (38) when the trigger mode is set to **Post** by button (40). The delay time can be set to a resolution of 5ns, but the size of steps by which the delay can be increased or decreased is dependent on the current timebase setting. Once set the delay time remains the same regardless of the selected timebase range.

Using the trigger menu, the delay can be set to any value directly, irrespective of the current timebase range.

The minimum delay is zero when the trigger point will be at the left hand edge of the screen. The maximum delay is 999s.

The current trigger delay setting is shown on the screen when the delay paddle (38) is adjusted. The delay setting can also be viewed on the Status menu (section 3.8) and altered on the Trigger Setup Menu (section 3.6).

1.10 Operating Hints

This section explains how to perform a system reset and gives some of the more commonly met problems in operating digital oscilloscopes, how to correct them, and a brief explanation of what was wrong. Later sections of the manual may need to be consulted as some of the operating features have not yet been discussed.

1.10.1 System Reset

Should the system memory become corrupted, the instrument could lock out the front panel operation or begin to behave erratically. Since the internal system variables are held in non-volatile memory, turning the set off an on again may not clear them. In this unlikely event a system reset may be necessary.

A system reset should only be used as a last resort as all the internal memories will be cleared erasing all reference traces, calibration details, and set-up details.

To perform a system reset, switch the instrument off. Press and hold the **Hold All** button. Keep the **Hold All** button pressed and turn the instrument on using the **Power** button. When a short beep is heard, the HOLD all button should be released. The instrument will then start up in its reset condition.

1.10.2 Problem: Traces and alphanumerics very dim or completely disappeared.

Intensities too low

- Use the Display **Intensity Menu** to adjust the various intensities.

1.10.3 Problem: Trace off the top or bottom of the screen.

Too much vertical shift

- Correct with that channel's **Position** button (25).

Input has large DC Offset

- AC couple the input signal using button (33).
- Correct using **Position** paddle (25).
- Use a less sensitive vertical range, button (29).

1.10.4 Problem: Trace not being acquired.

Instrument in single capture mode.

- Press **Run** (17).

Trigger level incorrect.

- Select **Auto** and **DC** trigger, buttons (43) and (46), then adjust the level control until the trigger level indicator bars are lined up with the center of the trace.

Trigger Source on the wrong input.
- Change the trigger source using button (48).

Trigger coupling on an unsuitable setting.
- Change trigger coupling using button (46).

Long trigger delay set.
- Either wait for delay to end, or shorten trigger delay.

Note: *During long delays a countdown is displayed near the bottom of the screen.*

Channel **Hold** or **Hold All** on.
- Release Hold using button (23) or (19).

Timebase on very slow acquisition.
- Adjust horizontal **Time/Div** (13).

1.10.5 Problem: Trace is unstable even when triggered.

Alias.
- Check for alias by selecting a faster timebase range and checking whether or not the display changes as expected.

Noisy input.
- Select **Hf rej** triggering (46).
- Adjust trigger level (39).

Trigger on Auto.
- With very low frequency inputs (below 20Hz), **Auto** trigger will initiate triggers over-riding the input triggers. Select **Norm** trigger (43).

1.10.6 Problem: Trace has very flat top or bottom.

Trace captured when off screen vertically and **position** shift has been used.
- Use less sensitive **V/Div** range when acquiring trace (29).
- Re-position trace prior to capture.

1.10.7 Problem: Auto Setup fails.

If Auto Setup fails it is most likely that the signal connected to the instrument is unsuitable for the automatic setup system for one or more of the following reasons.

Signal not repetitive.
- Auto Setup only works on repetitive signals

Signal amplitude too small or too large.
- Instrument needs to use a different V/Div range. Use a suitable probe, i.e. ×1, ×10, ×100 or ×1000 to obtain a signal level between 5mV and 400V.

Signal frequency too slow or too fast.
- The signal frequency is outside the range of Auto Setup.

Signal not constant.
- Amplitude and or frequency variations during the Auto Setup routine may interfere with its correct operation.

High frequency noise on signal.
- The noise may be interpreted as a high frequency signal instead of being ignored as noise on a lower frequency signal.

1.10.8 Problem: Cursor measurements apparently incorrect.

Wrong probe gain selected.
- Select correct probe gain to suit probe in use. See section 3.4.

Datum not set correctly.
- Re-position datum on trace (11) and (12).

Cursors on wrong channel trace.
- Position cursors on trace of interest (7).

Incorrect ABS/Δ selection.
- Select the correct cursor mode using button (6).

1.10.9 Problem: Cannot update traces as expected.

Only reference traces being displayed.
- Press Auto setup.

1.10.10 Problem: Single Shot acquisition takes longer than expected.

Averaging or persistence modes selected.
- Turn off both averaging and persistence.

An ETS timebase is in use with infrequent triggers.
- Use the Time/div paddle to change to a non ETS timebase.

An ETS timebase is in use with non repetitive or non triggered signal.
- Change to a non ETS timebase.
- Adjust the trigger controls to obtain a trigger signal.

2. DSO FEATURES

This section of the operators manual explains in detail how to use the various DSO acquisition and display modes and the plot output features of the instrument.

2.1 Capture Facilities

The capture facilities allow the traces on the display to be frozen.

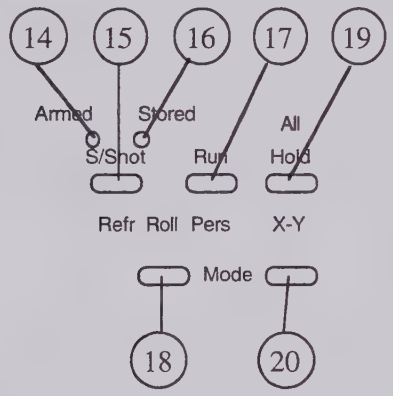


Figure 2.1 The Capture Controls

2.1.1 Trace Hold

There are three ways to hold or freeze the trace displays:

1) a single-shot capture whereby a full trace is acquired then frozen, section 2.1.2,

2) by pressing the **Hold All** button or

3) by pressing one of the individual channel **Hold** buttons.

Individual channels can be immediately frozen irrespective of the stage of any active acquisition by pressing the relevant channel **Hold** buttons (23). The associated Hold lamps light to show which channels have been held. To release a trace the **Hold** button should be pressed a second time and the hold lamp will go out. If Add is on when a channel is held then the other channel of the channel pair is also held.

Pressing the **Hold All** button (19) freezes all the displayed traces immediately regardless of the state of any on-going acquisition. The Hold All lamp lights to show that all traces have been held. A second press of this button releases all the traces and turns off the Hold All lamp.

To hold more than one trace at the same instant, press the **Hold All** button (19) then press the **Hold** buttons on the traces that you require. The individual channel hold lamps will illuminate. When all the required channels have been selected, press the **Hold All** button a second time. The selected channels will remain held while the others will be released. To release the held traces, press the relevant channel hold buttons.

2.1.2 S/Shot and Run

These two buttons (15) and (17) are used to set the instrument into either a single shot transient capture-and-freeze mode (**S/Shot**), or a free running continuous capture and re-capture mode (**Run**).

S/Shot (15) Arms the instrument for a Single Shot triggered acquisition. The armed light will be illuminated to show that the button has been pressed. If it is required that the instrument should remain in this state waiting for a trigger for more than 40ms, then Normal mode - section 1.8.6 - should be selected to prevent Auto triggers being generated.

Pressing S/Shot during a slow timebase capture (whilst in continuous mode) will freeze that capture upon "stored". Pressing S/Shot twice during a slow capture or during a slow Single Shot will rearm the scope immediately for a S/Shot capture.

Armed (14) Illuminates after the **S/Shot** button has been pressed; it will stay lit until either a valid trigger has been received or until the **Run** button is pressed.

Stored (16) Illuminated on completion of a single-shot acquisition. This is after the instrument has been armed, triggered and a complete trace acquired. The light will stay on until the instrument is rearmed by pressing either **S/Shot** again or **Run**.

2.2 Display Modes

There are four display modes on the DSO: Refreshed, Roll, persistence and X-Y. The first three of these are mutually exclusive. X-Y can be applied to any of the other three display modes. All the modes are available directly from the front panel using buttons (18) and (20).

2.2.1 Refreshed

The instrument will imitate the style of a conventional real-time oscilloscope and the display is plotted from left to right as it is acquired, overwriting existing data. In refresh with pretrigger, the display does not update until the pretrigger information has been acquired. This is only noticeable on slow timebases.

2.2.2 Roll

This mode is like a chart recorder. The display scrolls from right to left until a trace has been acquired. New data is written on the right hand side of the display.

The scrolling effect is most noticeable on the slower timebase ranges. The rolling display is frozen by the trigger in S/Shot mode but is unaffected by the trigger in Run.

Roll is only available on timebases of 50ms/div and slower. If the timebase is faster than 50ms/div, the display and trigger systems behave as in refresh mode.

2.2.3 X-Y

This mode allows the CH1 input to control the X (horizontal) component of the trace, and the other channel inputs to control the Y (vertical) component of the trace display. The display will show an X-Y display of the data captured by the timebase and trigger systems.

X-Y is available on all timebase ranges but the timebase should be set slow enough to capture the whole of the signal of interest. This mode is useful for showing Lissajous' figures.

2.2.4 Persistence

Is a refreshed mode in which successive acquisitions are added to the current display. The number of acquisitions or the time before clearing the display is set in the Persistence menu accessed from the Display Master Menu. The latest acquisition is shown brighter than the persisted acquisitions.

2.3 Cursors

The instrument allows you to take direct measurements from the screen display, using the datum and cursor lines. The cursor is also used to select a trace for post storage manipulation.

2.3.1 Cursor and Datum Selection

The cursor and datum lines are switched on or off using the select trace button (7). Successive presses of this button places the cursor and datum lines on to the displayed traces in turn. i.e. channel 1A, channel 1B, channel 2A, channel 2B, ...channel 4B, Off, channel 1A etc. If any of the traces are not in use, the lines skip to the next valid selection.

Note: *If X magnification, X shift, or other trace manipulation feature has been used, the cursor and datum lines may not be visible on the screen. To bring them back into view use the datum and cursor paddles as described below.*

2.3.2 The Cursor and Datum Lines

Once activated using the select trace button, 3 lines appear on the trace as shown in figure 2.3.2 below. Both the datum lines extend the full width or height of the display and the cursor is a short line that can be moved along the trace from sample to sample.

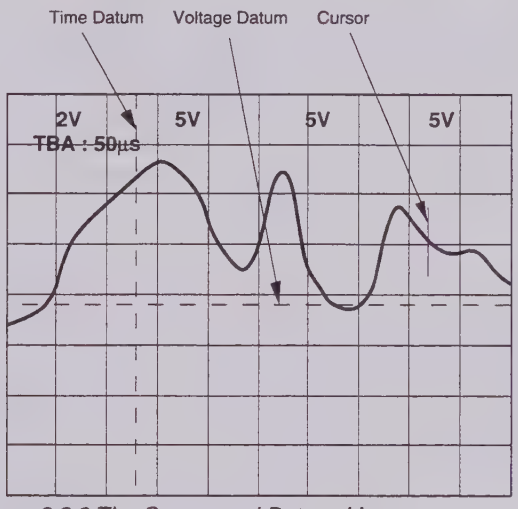


Figure 2.3.2 The Cursor and Datum Lines

Movement of these lines is achieved using the datum and cursor paddles (10), (11) and (12). All three of these paddles are Push Harder Go Faster controls (PHGF)

Paddle 12 moves the Voltage datum line up and down, unless the instrument is in ABS mode when the voltage datum is locked to the selected cursor trace ground.

Paddle 11 moves the Time datum line left and right and,

Paddle 10 moves the Cursor line left and right.

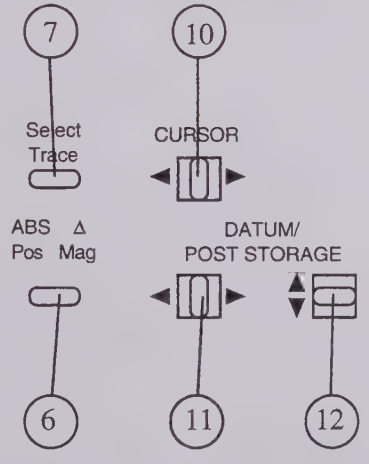


Figure 2.3.3 The Cursor and Datum Line Controls

2.3.3 Cursor Mode

The function of the cursor is selected using button (6). This has four selections: ABS (Absolute), Δ (Delta), Pos (Position) and Mag (Magnification). ABS and Δ are measurement modes and Pos and Mag are post storage manipulation modes. While in Pos or Mag mode, measurements are performed as in Δ mode.

If button (6) is pressed when the cursor has not been placed on a trace , the message NO TRACE SELECTED is displayed.

2.3.4 Making Measurements

When using the cursors in either ABS or Δ mode, the instrument displays, at the bottom of the screen, time and voltage or other special measurements as selected in the Cursor Measurements Menu, see section 3.25.

If Δ is selected, the time and voltage shown is the difference between the trace intersections of the horizontal and vertical datum lines and the cursor.

If ABS is selected, the voltage datum line is automatically positioned on the channel ground so that the voltage shown is the difference between the trace intersection of the cursor and ground. The time datum is not moved, but the time shown is the difference between the trace intersection of the cursor and the trigger point

Note: *Each channel's ground position may be in a different position on the screen.*

Placement of the cursor and datum lines at the desired positions is easier for the user at those points where the slope of the waveform is at its steepest. For example, on a standard sinewave, the easiest points to place the measurement lines to measure the wavelength are two 0V crossing points or points of inflection. If a trace is magnified then the cursor can be set more precisely and placed on the required sample.

2.3.5 Post Storage Manipulation

Stored traces can be manipulated using the Datum/Post Storage paddles (11) and (12) if the cursor mode is either Pos or Mag. This can be useful for measurements to be made between two or more waveforms as they can be precisely aligned with each other.

All post storage manipulation of waveforms can be cancelled by pressing the Restore button (numeric button **8**) which becomes available after any post storage manipulation. This feature Restores all traces to their original unmodified stored state.

To shift the selected trace in both the X and Y directions, select Pos and use the paddles. Paddle (11) shifts the trace horizontally (X) and paddle (12) vertically (Y).

To vary the vertical and horizontal magnifications of the selected trace, select Mag and use paddles (11) and (12). The magnification factor is shown at the bottom of the display. The Y mag range is from ×4 to ×0.062 and the X mag range is from ×4 to ×1.

Further trace manipulations are available through the menu system, see section 3.26. Unlimited combinations of manipulations can be applied to each trace.

2.4 Capture and Repeat

The last 16 poststorage events of any type are remembered by the DSO. A post storage event could be a positional change, a magnification, a filtering, an integration, an invertion or some trace arithmetic. Along with each event, the DSO stores the trace or traces on which the operation was performed allowing the exact same sequence of manipulations to be replayed later.

After any poststorage manipulation, various additional options appear on the trace display alongside numeric keys 5 and 6. These are CAP & REP, REPEAT RESTORE and INIT. Each of these functions is described below.

A maximum of two of these features is available at any one time depending upon the last actions performed on the DSO, e.g. if S/Shot is pressed after performing a post storage manipulation, CAP & REP will change to REPEAT since the capture has already been performed. The options available for different sequences of events are shown in figure 2.4 where the items on the arrowed lines describe the action performed.

CAP & REP Performs a single shot acquisition and then repeats the last post storage functions on the newly acquired traces, in the order in which they were performed.

REPEAT repeats the last post storage functions on each of the traces, in the order in which they were performed.

RESTORE returns all the modified traces to their original acquired state.

INIT Erases the post storage sequence from the DSO's memory, i.e. it initializes or resets the post storage manipulation memory.

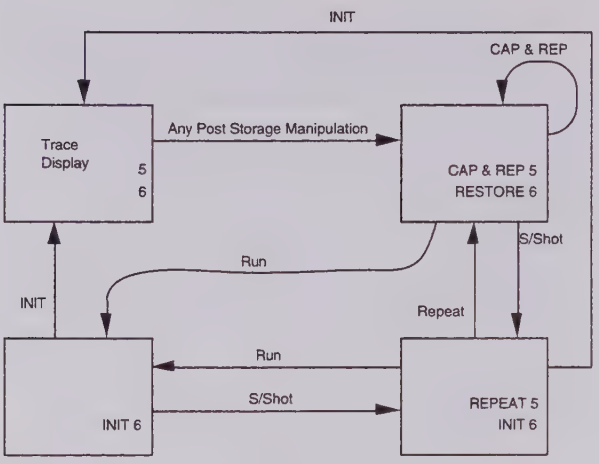


Figure 2.4 Capture and Repeat displays

2.5 Plot

A plot of the screen display and annotation can be obtained at any time by pressing the Plot button (49). Menus can also be plotted. The plot can be sent to the internal 4 color or thermal plotter if one is fitted, or it can be sent to an external HPGL plotter via the RS423 or GPIB interface if fitted.

When sending plots to an external plotter, μ will be converted to u and any special characters such as A_V and E_{TS} will be converted to a question mark (?).

The plot destination and parameters are set via the menu system. See section 3.13

Dot Join

The plotter will plot the dot joined image as it appears on the screen. If dot join is not required it should be turned off using the Dot join On/Off feature in the menu system. See section 3.9.1.

Reference Traces

Reference traces will be plotted if they appear on the DSO's screen.

Date and Time

The original date and time of the trace acquisitions and the current date and time will be plotted,

2.5.1 Internal Color Plotter

Each time the instrument is switched on while fitted with a color plotter, 4 small square test boxes are plotted, one using each of the four colored pens in the order black, green, blue, red. This allows the user to confirm that the pens are working and fitted in the correct position.

If the Message PLOTTER SERVICE RECOMMENDED appears next to the four test boxes on the plotter when the instrument is switched on, this means that the plotter has completed 300 hours of plotting and that in order to ensure that the plotter continues to perform efficiently and reliably, it is recommended that your plotter is serviced. Please contact your local agent for details.

When using the internal color plotter background plotting is provided as described below.

When the plot button is pressed, both the **Plot On** and **Hold All** on lamps light. After about 1 second the Hold All lamp goes out indicating that the plot data has been transferred to the plot buffer and that the instrument can be used again. The Plot On lamp will remain lit until the plot is complete when it will go out. Further presses of the Plot button during a plot are ignored.

To abort a plot while the Plot lamp is on, press the **Abort** button (53), the plot, possibly after a short delay will be aborted. Any changes to the instrument status during a plot will have no effect on the plot as the data has already been transferred and stored in the plot buffer. If a calibration occurs during a plot, the plot may slow down but there is no change to the stored data.

Plots of persisted displays may take longer than normal due to the number of traces that have to be plotted.

Color Plotter Paper

Selection The only recommended paper for use with the 104 color plotter is Gould plotter paper. Part No. 04101165 for a pack of eight rolls. Other paper may damage the mechanism or lead to mis-registered plots.

Loading

CAUTION: When loading paper, extreme care should be taken not to force any of the plotter mechanism. NEVER pull paper through by hand, always use the paper advance button to prevent damage to the plotter mechanism.

1. With scissors, cut the end of the paper square.
2. Open the plotter by depressing the cover catch and removing the cover.

3. Remove the shaft from the paper cradle and if the plotter has been used previously remove the cardboard tube from the shaft.
4. Insert the end of the paper into the slot in the bottom of the plotter feeding the paper from the underside of the roll as shown in figure 2.5.1 below.
5. Insert the shaft through the paper roll and fit the roll into the paper compartment.
6. Press the blue paper feed button until there is enough paper to pass the paper through the slot in the top cover.
7. Close the plotter cover and ensure that it latches shut.

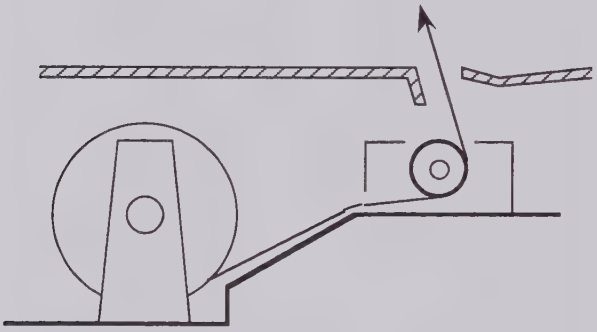


Figure 2.5.1 Color Plotter Paper Loading

Pen Installation and removal. Only Gould Pens should be used in the 104 color plotter. Part No. 04101175 for a pack of one of each color. Single color pen packs are also available contact your local agent for details.

The normal pen sequence is:

Pen No.	Color
1	Black
2	Blue
3	Green
4	Red

The pen holder carriage is color coded for this sequence.

CAUTION: When changing a pen, extreme care should be taken not to damage any of the plotter mechanism. NEVER move the pen carriage by hand.

To change a pen, ensure that the instrument is switched on and then proceed as follows:

1. Select the plot menu and press the pen change button - **8** - once. See section 3.13. This rotates the pen carriage and moves the carriage to the right hand side of the plotter.
2. Gently press the white grooved eject lever towards the front of the plotter mechanism. The top pen will be ejected from the pen carriage and can be removed from the plotter.
3. Insert the tip of the new pen into the carriage guide hole. Gently snap the other end of the pen into place.
4. When the pen has been changed, press the blue paper feed button and the carriage will move back to the left hand side ready for the next plot or to change another pen.

   Continue to change pens as required following the above steps.

2.5.2 Internal Thermal plotter

The thermal plotter option is a fast, high quality plotter, which provides hard copies of displayed or stored data in the form of single, or repetitive screen dumps. It can also plot menus. All plot parameters are user selectable through the instrument's menu system. See section 3.13.

The thermal plotter cannot plot persisted displays or transparent menus.

Note: *The head should be lifted whenever the plotter is not in use to prevent flat spots forming on the pressure roller.*

Thermal Plotter Paper

ActionThe thermal image is formed by a chemical reaction between a dye precursor and acceptor coated on the paper and stimulated by the application of heat. As with any chemical reaction the operating conditions should be tightly controlled for consistent results.

Selection The only recommended paper for use with the thermal plotter is Gould plotter paper. Part Number 04101251 for an 8 roll pack. The paper is matched to the print head characteristics and has been selected for sensitivity, definition and non-abrasiveness. Variations in these qualities affect print quality and head life. Low definition label grade papers are not suitable. A paper with different coating or thickness could lead to abnormal head deterioration, poor image definition and inaccurate print registration.

Any damage or wear caused by the use of inappropriate papers will invalidate the warranty.

Feed The paper is automatically advanced at the start and finish of each plot. Further paper can be fed through the mechanism by pressing the manual feed button. This blue button is situated in a recess in the plotter assembly.

Note: *Paper is fed while the button is pressed even if a plot is in progress.*

Loading

1. Remove and discard the first complete layer of paper from the roll, because it is sticky in order to hold the roll together and the glue can block up the plotter mechanism. With scissors, cut the end of the paper square.
2. Open the plotter by depressing the cover catch and removing the cover.
3. Remove the shaft from the paper cradle and if the plotter has been used previously remove the plastic tube from the shaft.
4. Insert the shaft through the paper roll and fit the roll into the paper cradle so that the paper feeds from the underside of the roll as shown in figure 2.5.2 below.
5. Pull the head lift lever forward (toward the side of the instrument) and insert the end of the paper into the plotter mechanism behind the pressure roller and push it through until the end of the paper reappears at the front.
6. Pull enough paper through to pass through the top cover, ensure that it is running around the plotter mechanism smoothly and that it is straight, then lower the head by pushing the head lift lever towards the rear of the plotter.
7. Close the plotter cover and ensure that it latches shut.

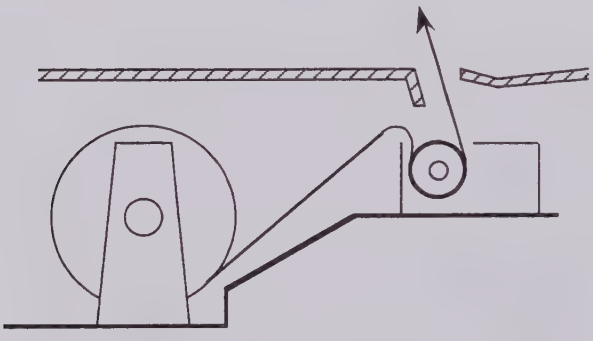


Figure 2.5.2 Thermal Plotter Paper Loading

Paper Storage For best results the thermal paper should be stored to avoid direct sunlight, moisture and fingerprints. The paper is desensitized by certain amines and esters.

Printed Image Archiving If the printed thermal image is stored in an ordinary manila file folder in the absence of light below 25°C (77°F) and with an average relative humidity of 65%, it will remain legible for a minimum of five years, provided that there is no contact with adhesive, solvent, or plasticizer bearing materials or vapors.

In general usage, degradation of the thermal image is caused by exposure to sunlight, moisture, adhesive tape, PVC folders or fingerprints, but it is tolerant enough to survive in a general "lab book" type environment below 54°C (130°F) with a relative humidity below 80%.

Plot Abort

A plot can be stopped by pressing the **Abort** button (53).

Error Messages

Under certain conditions, an error message relating to the thermal plotter will be displayed on the oscilloscope's screen. If a plot is in progress when an error condition occurs it will be aborted and any plots requested will be refused. The possible messages are:

PLOTTER OUT OF PAPER

PLOTTER HEAD RAISED

PLOTTER HOT ALLOW TO COOL

PLOTTER OUT OF PAPER is displayed if there is no paper in the plotter. Inserting more paper will remove this error.

PLOTTER HEAD RAISED appears if the plotter printing head lever is in the forward position with the head away from the pressure roller. Moving the head to the plotting position clears this condition.

PLOTTER HOT ALLOW TO COOL is displayed if the temperature of the print head rises above 70°C. The plot in progress will be aborted. Once the print head has cooled, plotting can re-commence. It is extremely unlikely that this message will ever appear.

3. The Menus

Many of the advanced features of the instrument are accessed through the menu system. The menu structure is summarized in figure 3. The numbers **1** to **8** refer to the numeric buttons used to select the particular menu or menu items, see section 3.1.1. All the front panel controls remain live when menus are displayed, allowing the control status to be changed at any time using either the front panel controls or the menu buttons.

The menus consist of rows of text each of which is in line with one of the numeric buttons. On some of the lines there are characters in inverse video, these show which option has been chosen. In some cases, when there are a large number of options, only the selected one is shown.

The inverse characters that are flashing signify that they are on the active line. The entry on this line can be changed by the relevant numeric button or by the horizontal datum paddle. This paddle is also useful for skipping over digits in numeric entry mode.

The vertical datum paddle can be used instead of the numeric buttons to change the active line.

3.1 Additional Buttons

3.1.1 The Numeric Buttons

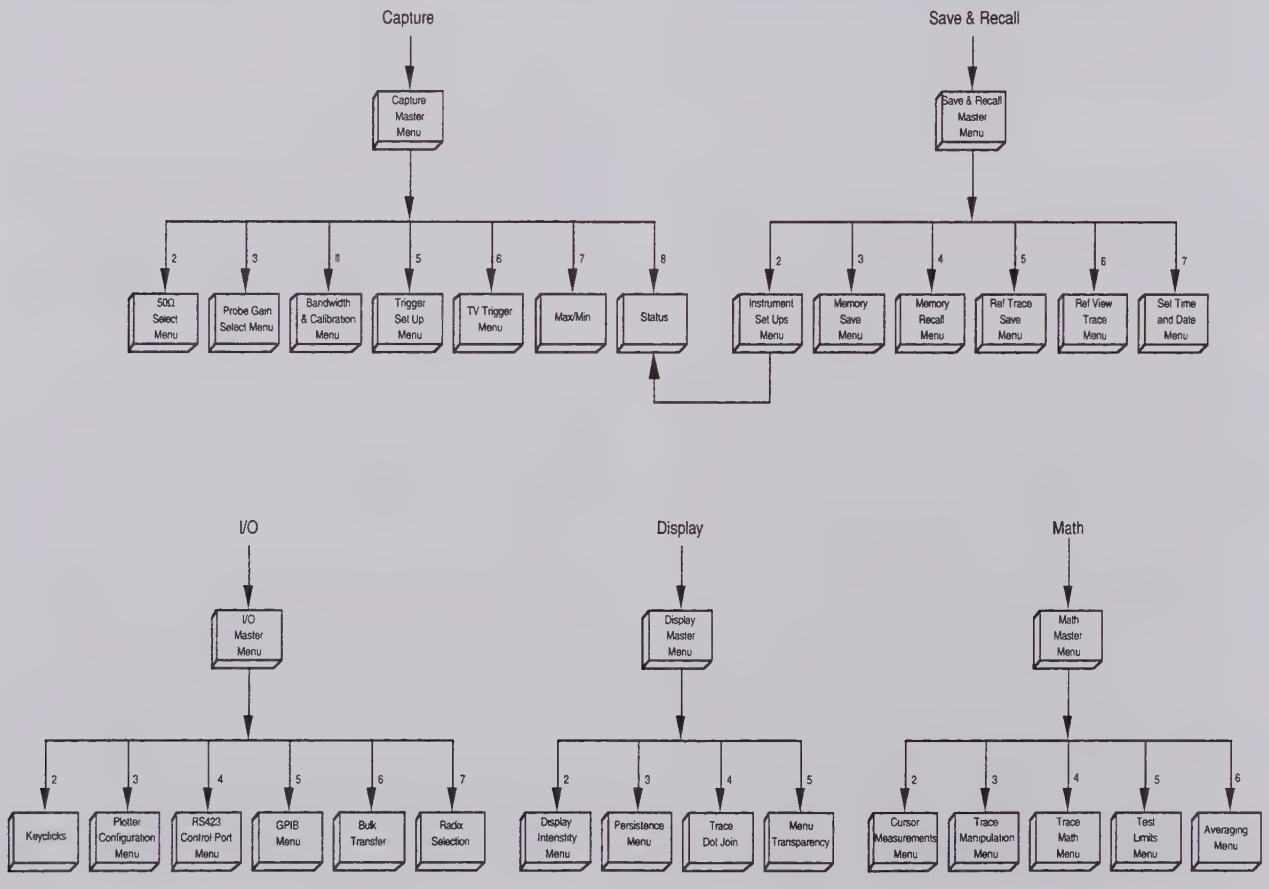
The buttons **1** to **8** (1) are used in conjunction with the menu system to provide a large number of extra functions not otherwise available directly from the front panel. Pressing these buttons when the menus are displayed operates the menu functions described in sections 3.2 to 3.29.

3.1.2 Menu/Traces

The **Menu/Traces** button (3) toggles the display between the traces and the last menu used.

3.1.3 Menus

There are 6 Menu buttons which each select a menu to replace the current display. These buttons are **Capture** (4), **Display** (9), **I/O** (5), **Save/Recall** (8), **Math** (2), and **F1** (50). Button F1 is reserved for future expansion.



3.2 Capture Master Menu

The Capture Master Menu contains a mixture of sub-menus and control selections. The text is aligned with the numeric buttons **2** to **8** (1) alongside the display. To obtain the sub-menu or control selection, press the relevant button.

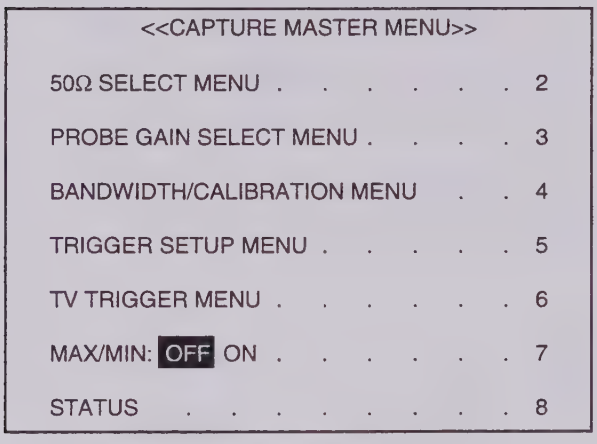


Figure 3.2 The Capture Master Menu

50Ω SELECT MENU. See section 3.3.

PROBE GAIN SELECT MENU See section 3.4

BANDWIDTH/CALIBRATION MENU See section 3.5

TRIGGER SET UP MENU See section 3.6

TV TRIGGER MENU See section 3.7

STATUS See section 3.8

3.2.1 MAX/MIN

This entry does not select a further menu, it directly controls the Max/min or glitch detect function. Each press of button **7** alternately turns Max/Min on and off.

Glitches are detected by a Max/Min capture system which is designed to detect narrow glitches that may occur between samples. It operates on the signal as it is captured and can detect narrow pulses down to 2µs wide. Any glitches detected will at least be displayed as a spike. They will be detected whether they are positive (max) or negative (min). The function works in the timebase ranges of 100µs/Div to 50s/Div.

Max/Min is useful for detecting aliases because if there are many maximum and minimum points in a capture these levels will be alternately stored thus building up an envelope of the true waveform. If the signal peak-to-peak amplitude is constant then the envelope will appear as two horizontal lines of data points with, if dot join is on, the band between these lines filled in.

3.3 50Ω Select Menu

The input impedance of each of the input channels can be independently set to either 1MΩ or 50Ω using this menu.

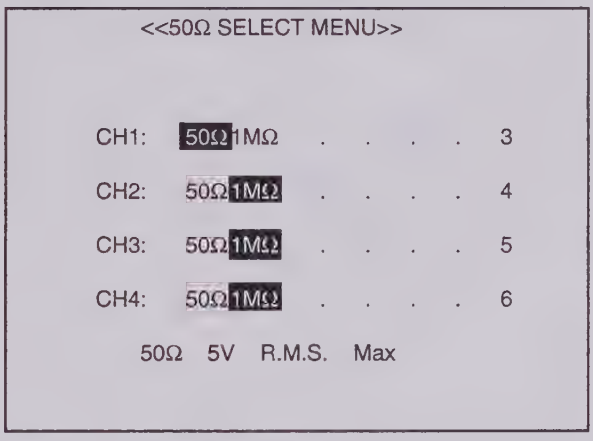


Figure 3.3 The 50Ω Select Menu

The numeric button alongside the required channel number on the display toggles the impedance between 50 and 1MΩ. While a channel's impedance is set to 50Ω the relevant front panel indicator (35) is illuminated.

AC coupling is not permissible with 50Ω inputs so DC coupling is automatically selected at the channel input.

CAUTION: The maximum input voltage to the instrument in 50Ω mode is 5V rms. Voltages in excess of this may damage the instrument and make it unsafe.

3.4 Probe Gain Select Menu

This menu is used to set the instrument to suit attenuating probes.

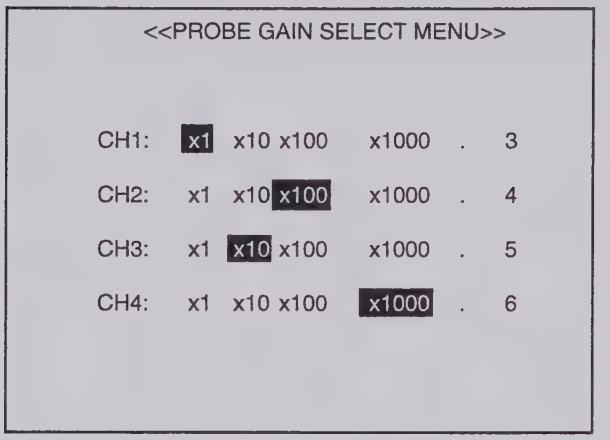


Figure 3.4 The Probe Gain Select Menu

An independent probe attenuation ratio can be set for each of the input channels with successive presses of buttons **3**, **4**, **5** or **6**. The available ratios are ×1, ×10, ×100 and ×1000. Once a ratio has been selected, if a probe of the chosen ratio is attached to the appropriate inputs, the new sensitivities at the probe tip will be displayed correctly on the screen.

These numbers merely factor the measurements and the displayed sensitivity for the users convenience.

A factored sensitivity is shown in inverse video.

3.5 Bandwidth & Calibration Menu

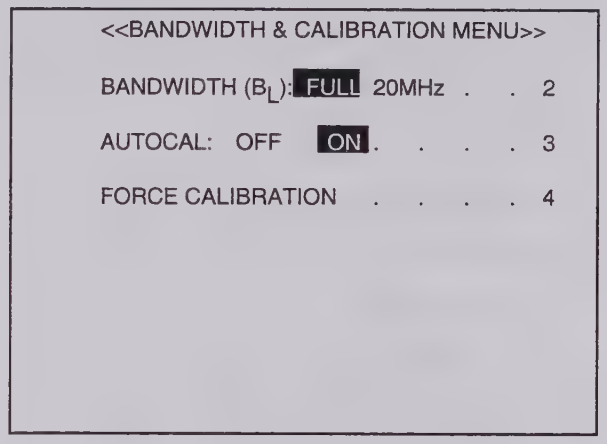


Figure 3.5 The Bandwidth & Calibration Menu

BANDWIDTH The bandwidth of all input channels can be limited to 20MHz using button **2**. This can be useful when the signals of interest have high frequency noise superimposed on them. When bandwidth limit has been turned on, the B_L symbol will appear at the upper right hand side of the trace display.

AUTOCAL The automatic calibration procedure has two variations: a standard and a temperature dependant calibration. A standard calibration balances the analog amplifiers and the trigger system and, additionally, every 7 days it performs a CCD gain and offset calibration.

A temperature dependant calibration balances the analog amplifiers and the trigger system. The instrument's auto calibration procedure can be enabled or disabled as required by pressing button **3**. The selected option is highlighted. Note that this option is not altered or defaulted at power on, so if a previous user has disabled calibrations this state will remain.

If autocal is enabled, a temperature dependant calibration is performed whenever the instrument is turned on. This is followed by an standard calibration 15 minutes after power up. Further temperature dependant calibrations will then occur only if the instrument's internal temperature changes by more than 10°C.

Each calibration takes about 10 seconds. If the occasional interruption of the normal operation of the instrument is unacceptable to the user, the autocal facility can be turned off. A forced recalibration is then recommended 15 minutes after switch on from cold and additionally if there is a significant change in the ambient operating temperature.

Note: *No channel calibrations will be performed if the instrument is armed waiting for a trigger, in a data capture (acquisition) cycle or in a continuous roll mode, they will simply be postponed until these conditions end.*

FORCE CALIBRATION Button **4** causes the instrument to perform a temperature dependant calibration of all channels and ranges. To obtain the best results from this function, the instrument should have been operating for at least 15 minutes.

Force recalibration is always available regardless of the instrument's acquisition status. Forcing a calibration will stop any acquisition that is in progress and will not store any data already acquired.

3.6 Trigger Setup Menu

The trigger set up menu is used to set up various trigger configurations and represent them diagrammatically.

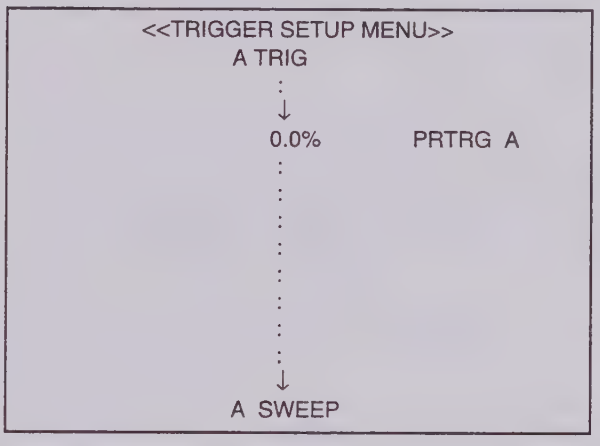


Figure 3.6a A Simple Trigger Menu

The menu shows the triggers entering at the top, either A trig only or A trig and B trig. The menu then shows how these triggers are used to initiate the horizontal sweeps.

The five functions that can be introduced into the trigger path are described below. At the end of this section is a description of how they may be combined to provide complex trigger functions.

This menu is a live display of the instrument trigger system so that any changes are actioned and displayed simultaneously.

Numerical Entry: Certain functions on the trigger menu require numbers to be entered. This can be done in two ways: The appropriate front panel control e.g. the delay paddle (38) can be used or the numeric buttons can be used to type in the required numbers.

To use the numeric keys, select the field to be changed by pressing the appropriate numeric key then:

1 The digits are entered one at a time, starting with the most significant digit -the left hand one- using the numeric keys.

2 The digit currently being entered is shown in inverse video.

3. After a digit has been entered the next one to the right is highlighted.

4. After all the digits have been entered the numeric buttons return to their normal menu functions.

5. If it is required to skip a digit or go back to a previous digit, the cursor paddle (10) can be used to move the entry point along the number and to leave the field to complete the entry.

To terminate numeric entry and deselect the feature at any time during input, press any channel control. The previous value is retained.

DELAY A/PRTRG A: This line shows either the amount of post trigger delay time set for the A sweep or the A trigger Pre trigger percentage. Post trigger delay is shown as a combination number with ., m, µ and ns as the separators. A number such as 012.452m372µ740ns means 12.452372740 seconds or 12 seconds, 452ms, 372µs and 740ns. Pre-trigger percentage can be set from 0.0% to 100.0% in 0.2% steps.

When using the paddles to enter a delay, the resolution of the delay steps is dependant on the timebase selected. Faster timebases have smaller delay steps. The steps are 2% of the timebase range or 5ns whichever is greater i.e. at 250ns/div the delay steps are 5ns while at 1s/div the delay steps are 20ms.

DELAY B: This line shows the amount of post trigger delay time set for the B sweep. It is shown as a combination number with ., m, µ and ns as the separators. A number such as 012.452m372µ740ns means 12.452372740 seconds or 12 seconds, 452ms, 372µs and 740ns.

The resolution of the delay steps is dependant on the timebase selected. Faster timebases have smaller delay steps The steps are 2% of the timebase range or 5ns whichever is greater i.e. at 250ns/div the delay steps are 5ns while at 1s/div the delay steps are 20ms.

GATE: This stands for B gated by A. Pressing the numeric key toggles the gate function on and off. The A sweep is unaffected and is initiated by a valid A trigger after the instrument has been armed. After the A sweep and a second valid A trigger, the B sweep is started by a B trigger with any B trigger Delay or B pre-trigger % applied.

PRTRG B: This line shows the B trigger pre-trigger percentage. This can be from 0.0% to 100.0% in 0.2% steps.

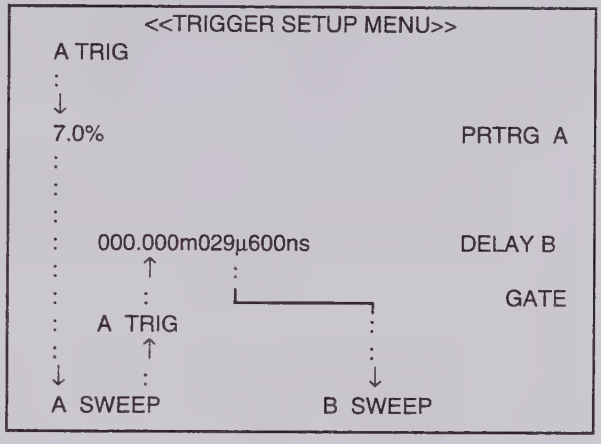


Figure 3.6b A Combined trigger setup Menu

The example in figure 3.6b shows a possible trigger setup. In this example the B sweep follows the A sweep and a second A trigger without the need for a B trigger.

The actual sequence resulting from this menu is as follows:

1 An A Sweep is initiated by a valid A trigger which has 7% pre trigger applied.

2. A second A trigger is received

3. After a delay of 29.6µs the B sweep is initiated.

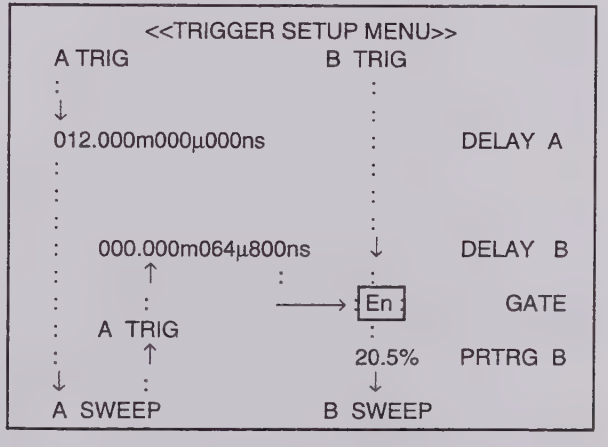


Figure 3.6c A Combined Function Trigger Menu

The example in figure 3.6c shows a possible trigger setup. In this example the B trigger is gated by the A trigger.

The actual sequence resulting from this menu is as follows:

1 An A Sweep is initiated 12 seconds after a valid A trigger.

2. A second A trigger is received

3. After a delay of 64.8µs the B trigger path is enabled.

4. The next valid B trigger has 20.5% pre trigger applied and initiates the B sweep.

Trigger Setup Example

To examine a particular line of a 625 line video signal, line 21 in this example, use the TV trigger menu to set the A trigger to TVF and use the trigger menu to set B gated by A with a B delay.

Line 1 of a 625 video frame is taken to be the first two half lines, these occur 129.5µs after the A trigger (frame sync trigger point). Line 21 is generally the first picture line so to display this on the DSO the B trigger needs to be enabled after the initial 129.5µs delay plus a further 1.28ms (20 lines x 64µs) which gives a total B delay of 1.4095ms

This setup is shown below.

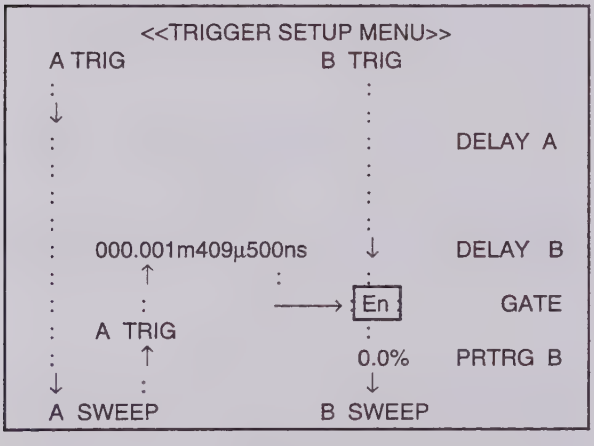


Figure 3.6d A Combined Function Trigger Menu

3.7 TV Trigger Menu

The TV Trigger Menu is used to set the parameters of the TV triggering facilities. A typical display is shown in figure 3.7.

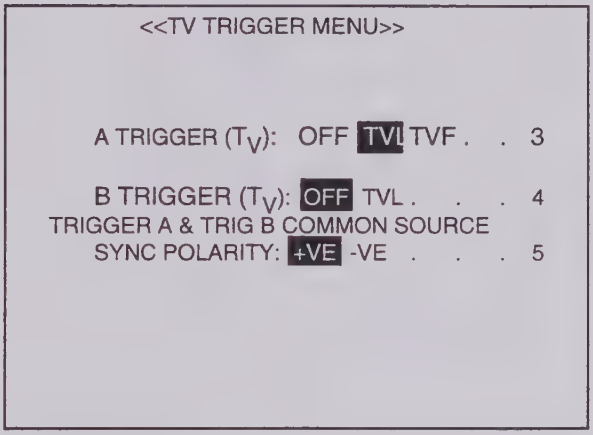


Figure 3.7 The TV Trigger Menu

A Trigger: Button **3** is used to set the A trigger system to respond to either TV Line (TVL) or TV frame (TVF) rate signals connected to the source selected by button (48). When TV trigger is in use, the T_V symbol will appear at the upper right hand side of the trace display.

B Trigger: Button **4** is used to set the B trigger system to respond to TV Line (TVL) rate signals connected to the A trigger source selected by button (48). When TV trigger is in use, the T_V symbol will appear at the upper right hand side of the trace display.

Note: the B TV Line trigger is derived from the A trigger Source.

Sync Polarity: Button **5** is used to determine the polarity of the TV sync pulses to which the trigger system will respond. The TV trigger system will reliably trigger with as little as one division of either 525 or 625 line composite video (0.3 div sync) of either polarity.

3.8 Status Menu

The Status Menu allows the various horizontal, vertical and trigger settings of the instrument to be viewed. A typical display is shown in figure 3.8.

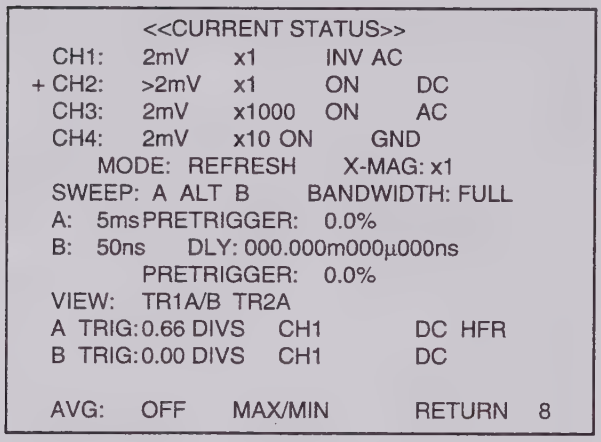

<<CURRENT STATUS>>
CH1: 2mV x1 INV AC
+ CH2: >2mV x1 ON DC
CH3: 2mV x1000 ON AC
CH4: 2mV x10 ON GND
MODE: REFRESH X-MAG: x1
SWEEP: A ALT B BANDWIDTH: FULL
A: 5ms PRETRIGGER: 0.0%
B: 50ns DLY: 000.000m000µ000ns
PRETRIGGER: 0.0%
VIEW: TR1A/B TR2A
A TRIG: 0.66 DIVS CH1 DC HFR
B TRIG: 0.00 DIVS CH1 DC
AVG: OFF MAX/MIN RETURN 8

Figure 3.8 A Typical Status Display

CH1 to 4: Following the channel number, the channel input sensitivity is shown in volts/div. The range is 2mV to 5V per division. If Add mode is selected, a + sign is shown in front of the second channel of the channel pair.

If a channel is uncalibrated, a > sign is shown in front of the sensitivity

After the sensitivities the probe gain settings are shown as ×1, ×10, ×100, or ×1000. These may be set using the Probe Gain Select Menu. See section 3.4

Next the channel status is shown. This will be either ON, OFF or INV. Finally on these lines, the input coupling is shown. This can be AC, DC or GND

Mode: There are three possible display modes: Refresh, Roll, and Persisted. X-Y can be applied to any of these. They are described in section 2.4.

X Mag: The status of any X magnification is shown as either ×1, ×2, ×5 or ×10. See section 1.6.4.

A and B: The sweep rate of the timebase is shown in s, ms, µs or ns per division followed by any Pretrigger % or trigger delay time.

A Trig and B Trig: The selected trigger options are shown in this part of the display. See sections 2.1 and 3.6

Averaging: If averaging is on, the averaging factor is shown as 2, 4, 8, 16, 32, 64, 128 or 256.

RETURN Pressing button **8** returns the display to the previous menu, either the Capture Master Menu or the Instrument Setup Menu.

3.9 Display Master Menu

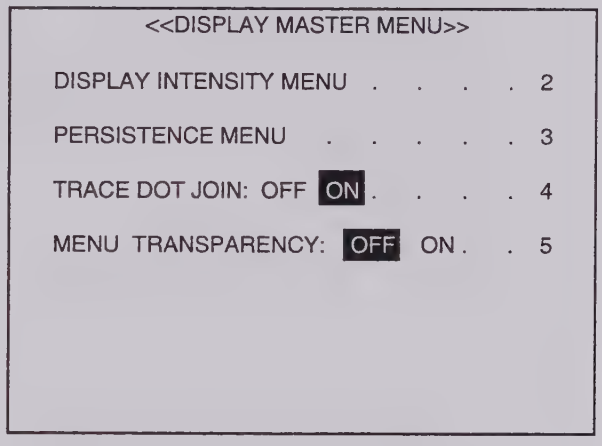


Figure 3.9 Display Master Menu

DISPLAY INTENSITY MENU This button selects the Display Intensity Menu which is used to vary the intensities of various items on the instrument's display. See section 3.10

PERSISTENCE MENU Selects the Persistence Menu which is used to adjust the persistence parameters. See section 3.11

3.9.1 Trace Dot Join

The individual dots making up a displayed trace can be joined together with linear vertical lines using this function. If Dot join is **Off**, gaps can be seen between the sample points on some traces, depending on the signal content. Selecting **On**, causes the dots to be automatically joined by vertical straight lines.

3.9.2 Menu Transparency

With this menu item, the Menus can be set so that they are either see through or solid. When they are see through (transparency **On**) the trace display and the menus are on the screen at the same time allowing the effects of menu items to be seen as they are changed. When transparency is off, selecting a menu replaces the trace display with the menu display.

This feature works with all menus except the Display Intensity Menu and the Test Limits Menu which are always transparent.

3.10 Display Intensity Menu

This menu is used to change the brightness of any of the items contributing to the overall display. This menu is always overlaid on the trace display so that the relative brightness of the display items can be compared.

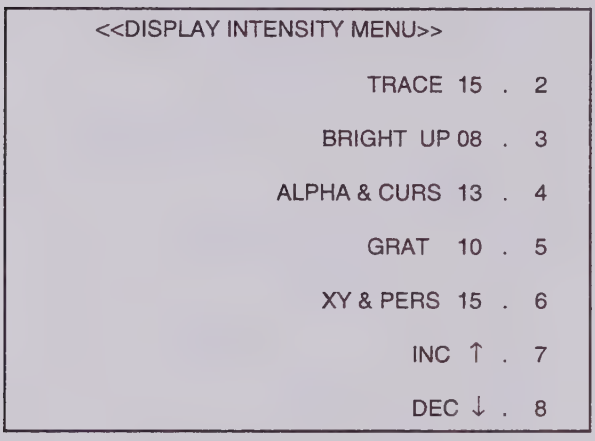


Figure 3.10 Display Intensity Menu

An item is selected by pressing the button next to it. Its intensity can then be changed by pressing either button 7 or button 8 to increase or decrease the level. Next to the item names on the screen is a number in the range 0 to 15 which is an intensity indicator (0 Off, 1 minimum brightness 15 maximum brightness). The Alpha brightness cannot be set to zero. These numbers change as the selection's intensity changes. They can also be remotely set and modified using either the RS423 or IEEE 488 interfaces.

Trace: Pressing button 2 selects all the channel traces.

Bright Up: Pressing button 3 selects the difference in between the two sections of a trace when using A alt B timebases. This control has the range 0 - 8 as it is a difference not an absolute brightness control.

Alpha/Curs: All the alphanumerics, the cursor and the datum lines are selected by pressing button 4. The alphanumerics include all channel and timebase data, any information relating to on screen measurements, all menus including the screen controls menu and any error messages. This item cannot be set to zero.

Grat: The brightness of the graticule can be adjusted by selecting it using button 5.

X-Y/Pers: Pressing button 6 allows the intensity of both the X-Y and Persisted displays to be adjusted.

Inc & Dec: Once an item has been selected, its brightness can be increased or decreased using button 7 or 8 respectively. Each press of a button changes the level one step, holding a button down causes the level to step through the levels until either the maximum or minimum is reached.

3.11 Persistence Menu

This menu is used for setting the persistence mode parameters. To turn persistence mode on or off use the Refr/Roll/Pers button (18) see section 2.4.4.

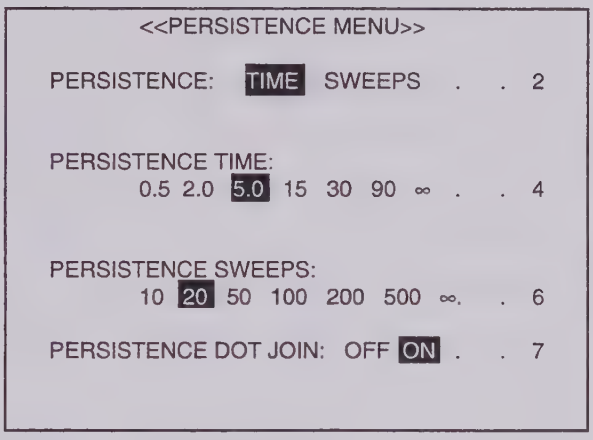


Figure 3.11 Persistence Menu

Persistence Either the number of acquisitions accumulated before the display is cleared or the absolute time between display clearances can be set from this menu.

The choice of Persistence for time or number of acquisitions is made using button **2** with the actual time or number of sweeps set by button **4** or **6** as appropriate.

Persistence Time Button **4** sets the time in seconds between screen clears when persistence mode is turned on. When this selection is set to ∞, the screen is never automatically cleared, (although the user may always press Run (17) or single shot (15), which will force a display clear), so the resulting display will be a composite picture of all the acquisitions performed from the point at which persistence mode was selected.

Persistence Cycles Button **6** sets the number of acquisitions between screen clears when persistence mode is selected. When this selection is set to ∞, the screen is never automatically cleared, (although the user may always press Run (17) or single shot (15), which will force a display clear), so the resulting display will be a composite picture of all the acquisitions performed from the point at which persistence mode was selected.

Persistence Dot Join The individual dots of each sweep making up a persisted display trace can be linearly joined by selecting Persistence Dot Join **On** using button **7**.

3.12 I/O Master Menu

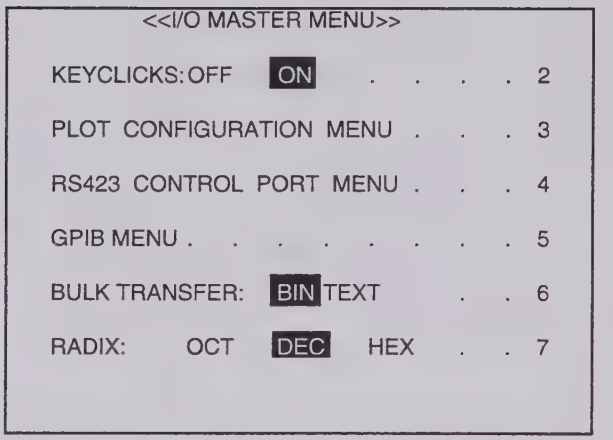


Figure 3.13 A Typical I/O Master Menu

Plotter Configuration Menu This button selects the Plotter Configuration Menu which is used to set the parameters of the plot. See section 3.13. This line only appears if a plotter or an option pod is fitted to the DSO.

RS423 Plotter Port Menu This button selects the RS423 Plotter Port Menu which is used to define the plotter port characteristics. See section 3.14. This line only appears if a plotter or an option pod is fitted to the DSO.

GPIB Menu This line only appears if an option pod is fitted and will either say GPIB MENU as shown or RS423 PORT MENU depending on which type of pod is fitted. See section 3.15 for the GPIB Menu or section 3.16 for the RS423 Port Menu.

3.12.1 Keyclicks: This line turns on and off the keyclick feature. If keyclicks are turned on then each time a front panel control is pressed a keyclick will sound giving a positive indication that the action was recognized.

3.12.2 Bulk Transfer: This option is used to select the data format for bulk transfers. The format can be either BINary, or TEXT. Binary mode is not compatible with RS423 communications using XON/XOFF handshaking because of the special handshaking characters which could also appear as data characters. In binary mode the data is transmitted as 'Definite Arbitrary Block Response Data' and is in the form #NLDDD...DD

Where:

N is a single digit and is the length of the length data. It will be either 1, 2 or 3

L is the length of the data transmission in bytes. This could be one two or three digits long.

DDD...DD is typically 502 bytes of binary trace data as used by the scope.

In TEXT mode each item of trace data is converted to ASCII data before transmission as 'Numeric Response Data' in the number base defined by the Radix entry.

3.12.3 Radix: This line only appears if the data format for bulk transfers is set to text. The numeric base for the data can be selected to be Octal Decimal or Hexadecimal.

When set to OCT, each data byte is preceded by #Q and the data is 'Octal Numeric Response Data'.

When set to DEC, the data is 'NR1 Numeric Response Data'.

When set to HEX, each data byte is preceded by #H and the data is 'Hexadecimal Numeric Response Data'.

Definite Arbitrary Block Response Data, NR1 Numeric Response Data, Octal Numeric Response Data, and Hexadecimal Numeric Response Data are all defined in the IEEE-488.2 specification and their use in the DSO conforms to that standard.

3.13 Plot Configuration Menu

This menu is only available if a plotter or interface pod is fitted to the instrument. It allows various plot parameters to be set.

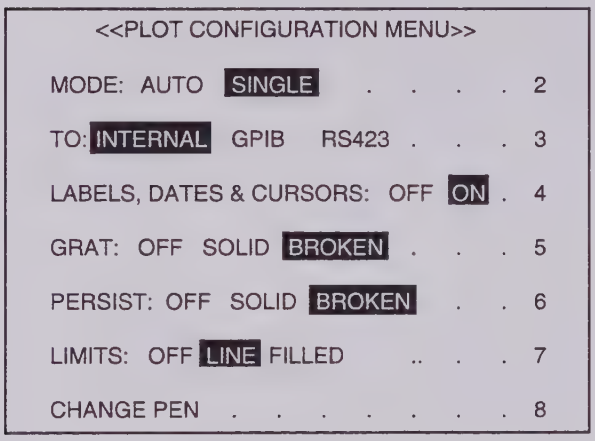


Figure 3.13 Plot Configuration Menu

There are 3 possible plot types set from this menu. They are plots to an internal (color or thermal) plotter and plots to an external plotter via either an RS423 or a GPIB interface.

Many of the features set on this menu are common to each of the plotter types and they are discussed below. Features unique to individual plotter types are described under the appropriate headings.

Mode:

Single: If single is selected, each time the plot button (51) is pressed a plot of the current screen display will be initiated. During data transfer to the plot buffer the instrument is held and the front panel controls are inoperative. When the data has been transferred the instrument is released. The data transfer typically takes less than a second. Pressing the abort button (53) will abort the plot.

Trace plots will contain a complete copy of the instrument's display including the datum lines and measurement cursor if they are turned on. Menu plots will simply be a copy of the screen display. Transparent menu plots will be a complete copy of the display including both trace and menu data.

Auto Plot: In Auto mode the plot sequence is started by pressing the plot button (51). A plot is initiated after the current acquisition is complete and once the plot is complete, the instrument rearms and waits for the next trigger, when it will again acquire the input signals. When this acquisition is complete another plot is initiated.

This process will repeat until the abort button (53) is pressed, or Auto plot is de selected in the menu.

TO: Selection 3 allows the required plot destination to be selected. When only one destination is available, i.e. when either an internal plotter is fitted **or** an I/O pod is fitted but not both, this line simply displays the destination and does not allow other selections.

Internal: Choose this option if either an internal color or thermal plotter is fitted and is required to be the plot destination.

GPIB: This item should be selected if the required plot destination is an external plotter connected via the GPIB interface.

The plotter must be in listen only mode.

Note that in order to function correctly all the address switches on an HP7475 plotter must be switched to 1.

The DSO communicates with an external plotter using HPGL.

RS423: This item should be selected if the required plot destination is an external plotter connected via either the RS423 or GPIB interface using the RS423 connections. The plotter must be connected to the RS423 PLOT O/P connector - the lower connector - on the RS423 or GPIB interface pod fitted to the rear of the instrument.

The pin connections for the interface connections are listed below in table 3.13 and typical connection diagrams for RS423 interfacing cables are shown below in figure 3.13c. A DSO to Gould 6120 cable may be ordered from service centers and distributors, part number 04091197.

The DSO communicates with an external plotter using HPGL.

RS423, Bi-directional control

Pin	Function
1	Protective Ground
2	RXD (in)
3	TX (out)
4	CTS (in)
5	RTS (out)
7	0V signal

RS423 Plot O/P port

Pin	Function
1	Protective Ground
2	RXD (in)
3	TX (out)
6	DSR (out)
7	0V signal
20	DTR (in)

Table 3.13

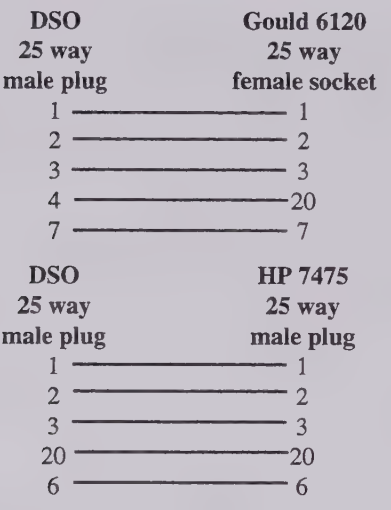


Figure 3.13c RS423 Interface cables

LABELS, DATES & CURSORS: All the alphanumerics that can appear on the plots can be included or omitted depending on the highlighted option selected with button **4**

If the alphanumerics are turned on, all the on screen labeling including GPIB entries, cursors and waveform processing measurements are reproduced on the plots. The trace labeling is not user programmable.

This selection does not affect menu plotting which will always appear if a menu is displayed.

GRAT: The graticule can be plotted as solid or broken lines or omitted from the plots by selecting the required option using button **5**.

Persistence: Persisted displays can be plotted as dots or solid lines or omitted by selecting the required option using button **6**.

Limits: When the Limits display feature (see section 3.28) is turned on, and an internal plotter is selected line 7 appears. This is used to determine how the limits traces are plotted. They can be omitted (OFF), shown as ordinary trace LINES or the area between them can be FILLED with vertical lines. The choice is made using button **7**.

Color Plotter

When an internal color plotter is fitted to the instrument, an extra line appears on the plot menu alongside button **8**;

PEN CHANGE 8

Pressing this button causes the pen carriage to rotate one position. This is used when changing pens. See section 2.7.

Thermal Plotter

When a thermal plotter is fitted to the instrument, the graticule - if it is turned on - is plotted as broken lines.

3.14 RS423 Plotter Port Menu

This menu is only available if an RS423 pod is fitted to the instrument and allows the RS423 communication parameters to be set.

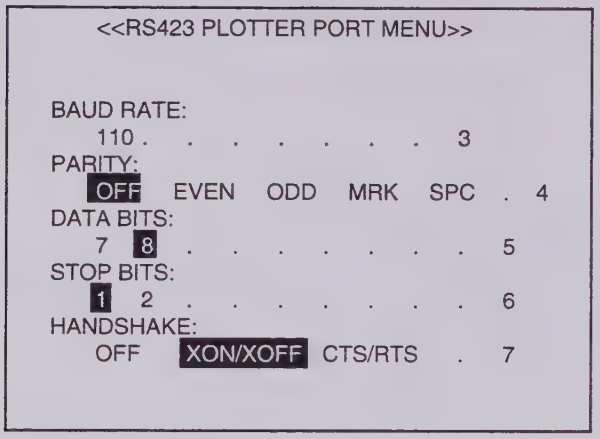


Figure 3.14 RS423 Plotter Port Menu

Data communication is always with one start bit. Other data parameters can be set using buttons **3** to **7**.

Baud Rate: Pressing button **3** steps around the possible baud rates which are 110, 300, 600, 1200, 2400, 4800 and 9600 baud.

Parity: The parity can be set to None (Off), Even, odd, Mark (MRK) or Space (SPC) by successive presses of button **4**. When the parity is set to Mark, the parity bit is always sent and it is always set to a logic 1. When the parity is set to Space, the parity bit is always sent and it is always set to a logic 0.

Data Bits: Each byte of data can be sent as either 7 or eight bits as shown by the highlighted option selected with button **5**.

Stop Bits: Either one or two stop bits can be sent as selected by button **6**.

Handshake: Communication handshaking can be set using button **7**. Handshaking can be turned off or set to XON/XOFF (software) or CTS/RTS (hardware) handshaking.

3.15 GPIB Menu

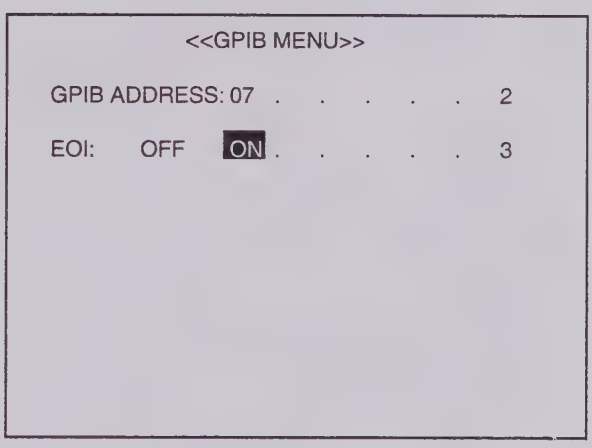


Figure 3.15 GPIB Menu

GPIB ADDRESS: The GPIB address can be set to any number from 1 to 31 by pressing button **2**. Each press of button 2 will increase the address by 1.

EOI: EOI (End or Identify) can automatically be inserted at the end of each transmission if ON is selected with button **3**. The EOI is a dedicated bus line which can be used in addition to carriage return and line feed to denote the end of a transmission and/or the end of a block.

3.16 RS423 Control Port Menu

This menu is only available if an RS423 pod is fitted to the instrument and allows the RS423 communication parameters to be set.

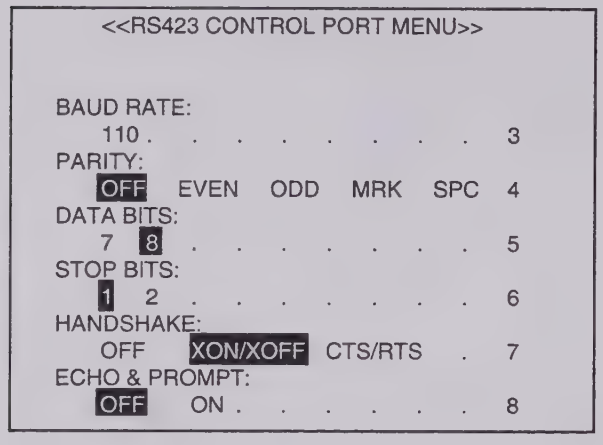


Figure 3.16 RS423 Control Port Menu

Data communication is always with one start bit. Other data parameters can be set using buttons **3** to **7**.

Baud Rate: Pressing button **3** steps around the possible baud rates which are 110, 300, 600, 1200, 2400, 4800 and 9600 baud.

Parity: The parity can be set to None (Off), Even, Odd, Mark (MRK) or Space (SPC) by successive presses of button **4**. When the parity is set to Mark, the parity bit is always sent and it is always set to a logic 1. When the parity is set to Space, the parity bit is always sent and it is always set to a logic 0.

Data Bits: Each byte of data can be sent as either 7 or eight bits as shown by the highlighted option selected with button **5**. 7 bit data is normally used for text and 8 bit data should be used for data transfer. 7 bit binary transfer is not sensible!

Stop Bits: Either one or two stop bits can be sent as selected by button **6**.

Handshake: Communication handshaking can be set using button **7**. Handshaking can be turned off or set to XON/XOFF (software) or CTS/RTS (hardware) handshaking.

ECHO & PROMPT: All characters sent to the DSO will be echoed back to the transmitting device and a prompt sent to the user if this option is set to On using button **8**.

3.17 Save & Recall Master Menu

This menu is used to select the instrument's memory management menus and also to set the internal clock.

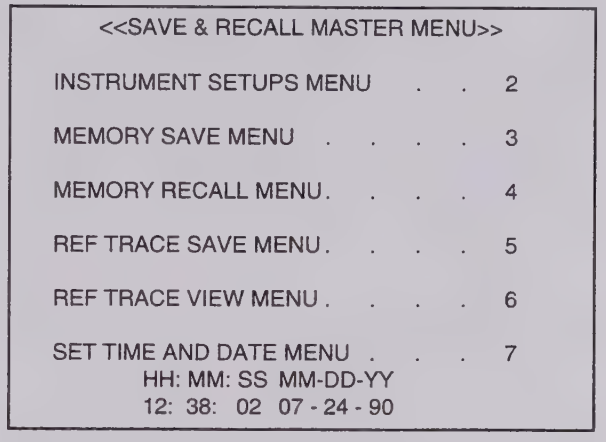


Figure 3.17a Save & Recall Master Menu

Figure 3.17b is a diagram of the memory management system that shows which of the menus, accessible from the Save & Recall master menu, is used to transfer trace information from place to place, e.g. to transfer an acquired trace to memory, use the Memory Save Menu.

INSTRUMENT SETUPS MENU: See section 3.18

MEMORY SAVE MENU: See section 3.19

MEMORY RECALL MENU: See section 3.20

REF TRACE SAVE MENU: See section 3.21

REF TRACE VIEW MENU: See section 3.22

SET TIME AND DATE MENU: The current time and date held by the instrument is displayed below this line. If required, these settings can be changed by selecting the Set Time and Date Menu by pressing button **7**. See section 3.23.

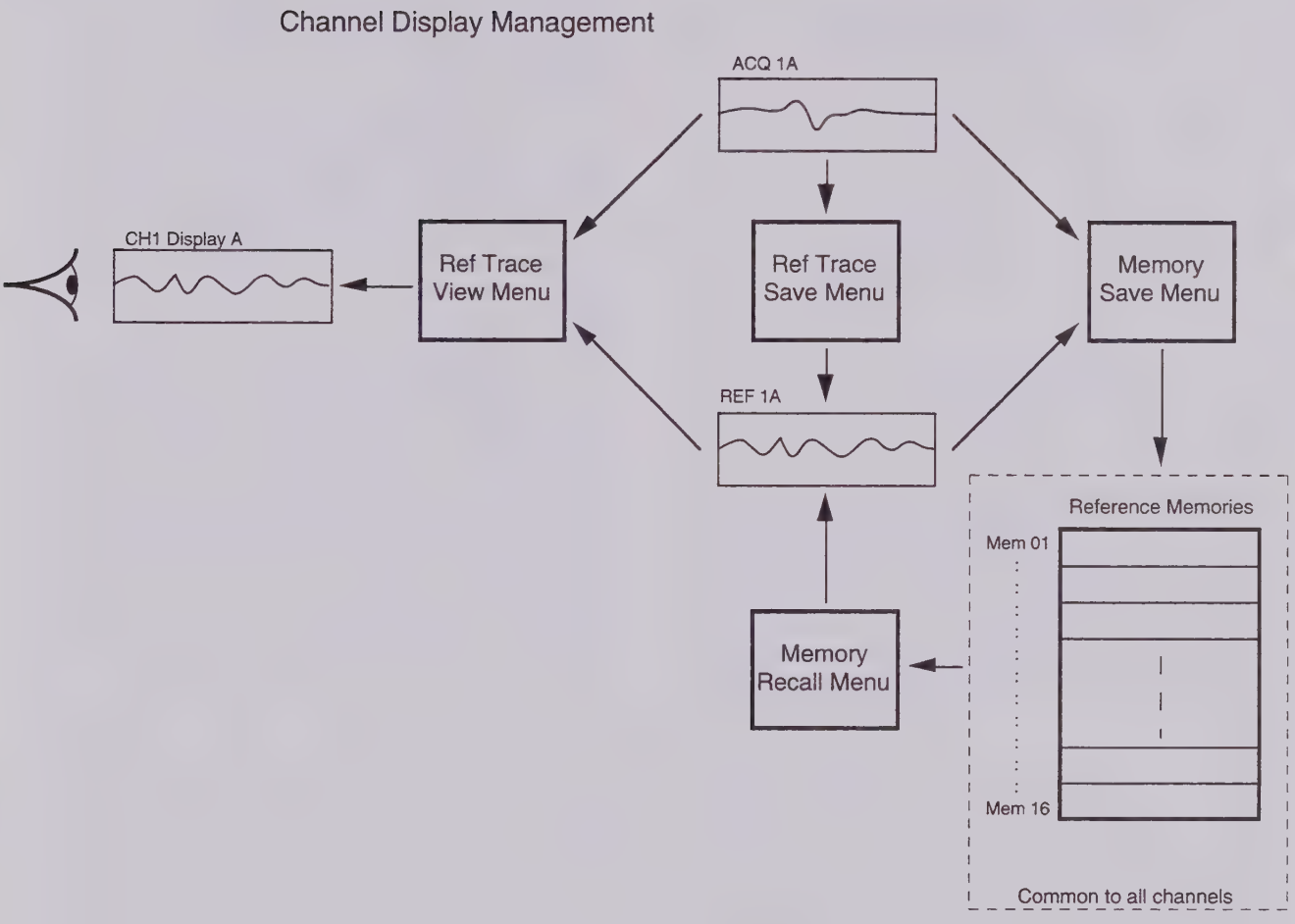


Figure 3.19b Memory Management

3.18 Instrument Setups Menu

This menu is used to save and recall up to 8 instrument setups. Each set up contains full information about the instrument status including all channel and trigger settings.

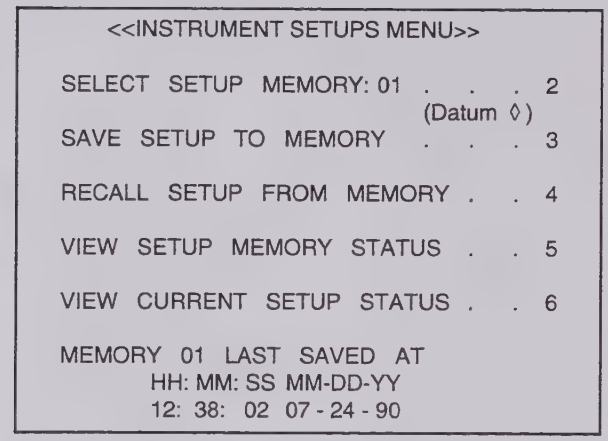


Figure 3.18 Instrument Setups Menu

SELECT SETUP MEMORY: This entry is used to determine which of the eight setup memories is to be saved to or recalled from. Each press of key 2 will select the next setup memory in a roll round list. Alternatively the datum paddle may be used to roll through the list.

SAVE SETUP TO MEMORY Pressing button **3** saves the current instrument setup to the setup memory selected on line 2.

RECALL SETUP FROM MEMORY: To replace the current instrument setup with the setup from the setup memory selected in line 1, press button **4**. After pressing button 4 the message Press Again To Confirm appears. A second press of button 4 will then recall the setup, any other key press will not recall the setup.

Use this feature with caution as all the instrument parameters may change including for example any complex trigger arrangements.

To prevent damage to the input circuitry if a voltage greater than 5V happens to be connected to an input channel when a setup with a 50Ω termination included in it is recalled, the message 50Ω in setup Press again to Confirm appears. Once again, a second press of button 4 will then recall the setup, any other key press will not recall the setup.

VIEW SETUP MEMORY STATUS: Pressing button **5** shows on the screen a status menu for the memory selected in line 2. The menu features are as described in section 3.8.

VIEW CURRENT SETUP STATUS: Pressing button **6** shows on the screen a status menu for the current instrument setup. This menu is exactly the same as that obtained from the Capture Master Menu as described in section 3.8.

MEMORY LAST SAVED AT: The last two lines of the Instrument Setups Menu show the time and date when the memory selected in line 2 was last saved.

3.19 Memory Save Menu

This menu is used to save traces to the 16 reference memories. See figure 3.17b.

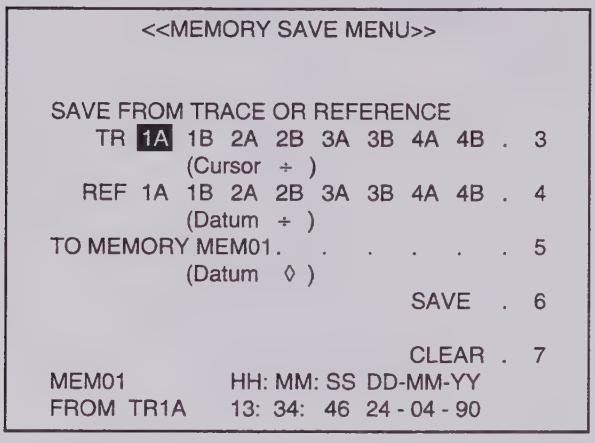


Figure 3.19a Memory Save Menu

SAVE FROM TRACE OR REFERENCE: This entry is used to determine which trace or reference display is saved. The trace to be copied must be currently displayed.

TR Pressing button **3** selects a trace. The cursor paddle (10) can also be used to move along this line.

REF Pressing button **4** selects a reference trace to be saved. The horizontal datum paddle (11) can also be used to move along this line.

TO MEMORY: Button **5** is used to select which memory the trace or reference will be stored in. The datum vertical paddle (12) can also be used to change this number. There are 16 memories available.

SAVE: Pressing button **6** copies the selected trace or reference into the selected memory.

CLEAR: Pressing button **7** clears the selected memory.

The last two lines of the Memory Save Menu show the time and date when the memory selected in line 5 was last saved and also which trace it was saved from.

3.20 Memory Recall Menu

This menu is used to recall traces from memory to reference trace displays. See figure 3.17b.

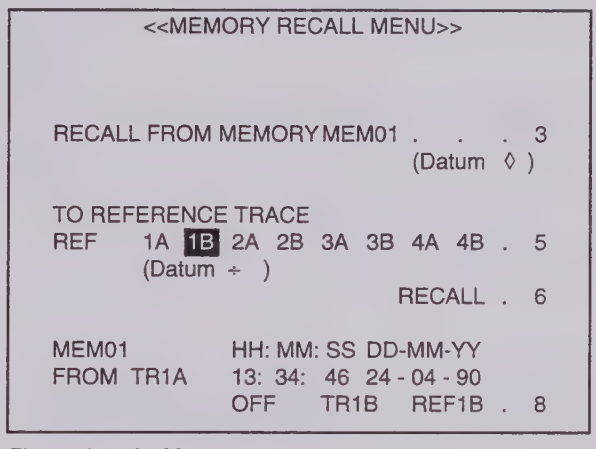


Figure 3.20 Ref Memory Recall Menu

RECALL FROM MEMORY This entry is used to determine which memory the trace will be recalled from. Pressing button **3** selects the memory. The vertical datum paddle (12) can also be used to change the memory number.

TO REFERENCE TRACE Pressing button **5** selects the reference trace that the memory will be recalled to. The horizontal datum paddle (11) can also be used to move along this line.

RECALL: Pressing button **6** copies the selected memory into the selected display.

The next two lines of the Ref Memory Save Menu show the time and date when the memory selected in line 5 was last saved and also which trace it was saved from.

VIEW: Either the recalled reference trace or the current channel trace can be displayed on the screen but not both, button **8** selects which of these is displayed on the screen.

3.21 Ref Trace Save Menu

This menu is used to save up to 8 reference traces from the trace display to the reference displays. See figure 3.17b.

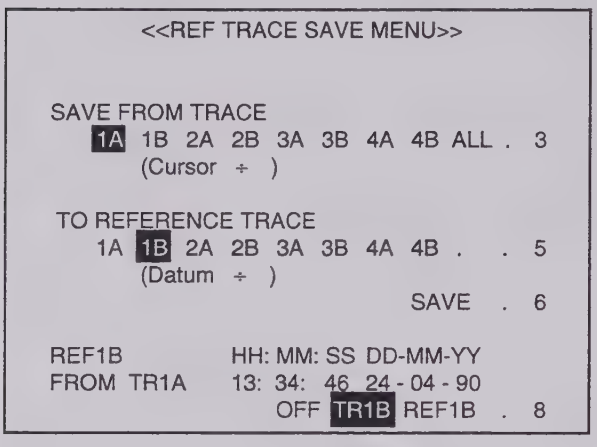


Figure 3.21a Ref Trace Menu

SAVE FROM TRACE This entry is used to determine which trace display is saved. The trace must be currently displayed. Pressing button **3** selects a trace. The cursor paddle (10) can also be used to move along this line. If ALL is selected, all the traces will be copied to corresponding reference memories; trace 1A to memory 1A etc.

TO REFERENCE TRACE Button **5** is used to select which reference trace memory will be used to store the trace. The datum vertical paddle (12) can also be used to change this number. There are 8 memories available. If ALL is selected on line 3, all the memories on this line will be highlighted.

SAVE: Pressing button **6** copies the selected trace into the selected memory.

The next two lines of the Ref Trace Save Menu show the time and date when the memory selected in line 5 was last saved and also which trace it was saved from.

OFF TR1B REF1B Button **8** is used to determine whether the reference trace selected in line 5 is turned On or Off. If All is selected on line 3, this line will change to read VIEW TRACE MENU. Pressing button **8** under these conditions will change the display to the View Trace Menu. See section 3.22.

3.22 Ref Trace View Menu

This menu is used to determine which displayed traces are reference traces and which are channel traces. See figure 3.17b.

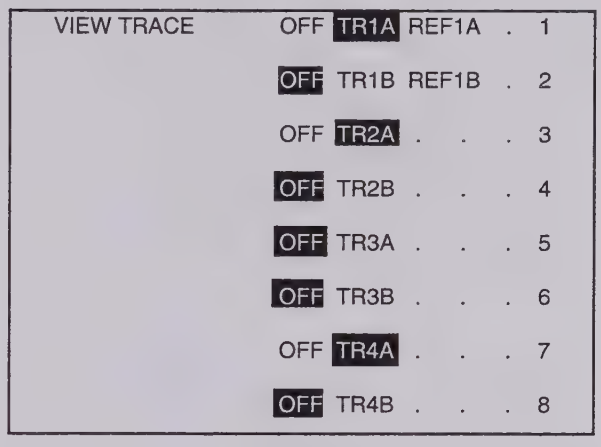


Figure 3.22 Ref Trace View Menu

For each A or B trace, the displayed trace can be selected to be either the acquired trace (e.g. TR1A) or the reference trace (e.g. REF1A) using the button alongside the entry. The selected option is highlighted. OFF shows that a channel is not turned on.

The reference trace option only appears alongside the appropriate button if either an acquired trace has been save to a reference trace using the Ref Trace Save Menu or a memory has been recalled to a reference trace using the Memory Recall Menu. See figure 3.17b for further details.

For each channel pair (1 & 2 and 3 & 4), three traces can be displayed at once. Attempting to display all four possible traces for a channel pair will

3.23 Set Time and Date Menu:

The DSO is fitted with a real time clock which can be set from this menu. The clock is kept running even with the power disconnected for at least ten years by its own internal battery back-up.

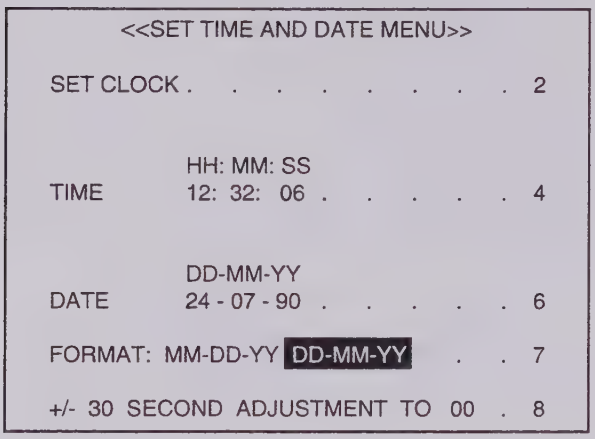


Figure 3.23 A Date and Time Menu

The current date and time together with the date and time of acquisition will appear on any screen plot.

SET CLOCK: Once the correct date and time has been set, pressing button **2** enters the data. This makes it easy to set a time that is a few seconds in advance of the real time and then press button **2** at a time signal. If the menu is exited without pressing button **2**, then the date and time will remain unchanged.

TIME: The current time shown on this line can be changed by pressing button **4.** Once button 4 has been pressed the first digit of the time will be shown in inverse video. To change this number press the required numeric key, the highlight will then move to the next digit. Repeat this until all digits have been entered. To skip a number or return to a previous digit the cursor paddle can be used to move the highlight along this line.

DATE: The current time shown on this line can be changed by pressing button **6.** Once button 6 has been pressed the first digit of the date will be shown in inverse video. To change this number press the required numeric key, the highlight will then move to the next digit. Repeat this until all digits have been entered. To skip a number or return to a previous digit the cursor paddle can be used to move the highlight along this line.

FORMAT: The date format can be switched between European or American formats using button **7.** Once a format has been selected, all places where dates are used, such as plots and GPIB/RS423 commands, will use and plot in that format.

+/- 30 SECOND ADJUSTMENT TO 00: Pressing button **8** forces the current time to jump to the nearest whole minute and zero seconds, i.e. forward or backwards a maximum of 30 seconds. If the time is from 1 to 30 seconds the time will jump back and if it is from 31 to 59 seconds the time will jump on to the next minute.

3.24 Math Master Menu

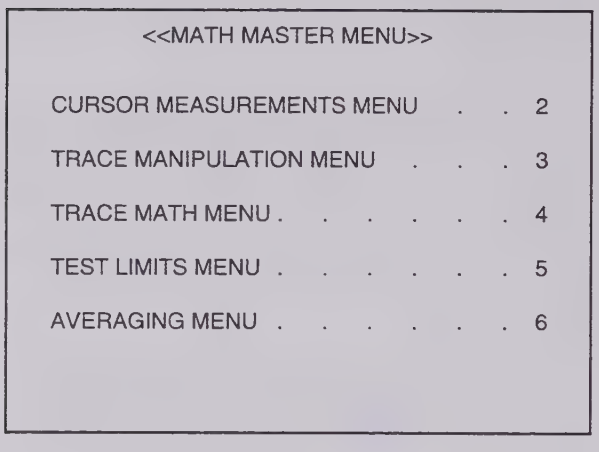


Figure 3.24 Math Master Menu

CURSOR MEASUREMENTS MENU Pressing button **2** selects the Cursor measurements Menu which is used to perform various cursor measurements on a selected trace as described in section 3.25.

TRACE MANIPULATION MENU Pressing button **3** selects the Trace Manipulation Menu which is used to filter, invert or integrate a selected trace as described in section 3.26.

TRACE MATH MENU Pressing button **4** selects the Trace Math Menu which is used to perform mathematical functions on selected traces as described in section 3.27.

TEST LIMITS MENU Pressing button **5** selects the Test Limits Menu as described in section 3.28.

AVERAGING MENU Pressing button **6** selects the Averaging Menu as described in section 3.29.

3.25 Cursor Measurements Menu

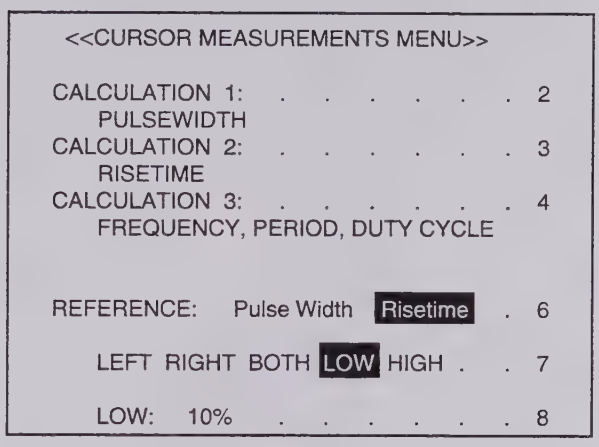


Figure 3.25. A Cursor Measurements Menu

Calculation1, 2 and 3: Three simultaneous calculations can be selected using buttons 2, 3 and 4. Each calculation is selected from a roll around list containing the following options. Voltage & Time, Voltage & 1/Time, Peak to Peak, Max & Min, Rise & fall time, Overshoot, Pulse Width, Frequency Period Duty Cycle, RMS & AC RMS, Area, Top & Base, Amplitude (Top-Base) and Off.

Several of these calculations automatically perform the Top and Base measurement to obtain the requested result. See section 3.25.1 for details of the Top & Base routines.

A calculation can only be selected once e.g. if calculation 1 is set to its default of Voltage and Time, then Voltage and Time will not appear in the possible selections for calculations 2 or 3.

The calculation results are displayed in the three lines at the bottom of the trace display; figure 3.25.1a shows an example.

If all the cursor measurements are set to off, no cursor measurements are shown next to the cursor trace label at the bottom of the screen.

Reference, Left, Right, Both High Low. These lines on the menu only appear when certain calculations are selected, see the calculation sections 3.25.2 to 3.25.12.

3.25.1 Cursor Measurements

The DSO has 3 user controlled datum and cursor lines for use with this section of facilities. Their operation is described in section 2.3. The cursor is moved along the selected trace using the cursor paddle (10) and the two datum lines are moved using the datum paddles; the time datum line with paddle (11) and the voltage datum with paddle (12).

The cursor is used to determine the trace of interest and the cursor and time datum lines define the portion of the trace to be measured. In Δ mode, voltage measurements are with respect to the voltage datum line and time measurements are with respect to the time datum. In ABS mode voltage measurements are with respect to the channel GND level and time measurements are with respect to the trigger point.

If any part of the measured waveform is off the screen, the cursor text line will show O/R meaning Over-Range.

Note that the channel ground and the trigger point may not necessarily be within the display area.

When time measurements are made in absolute mode, the notation "Abs" is shown on the screen and on plots.

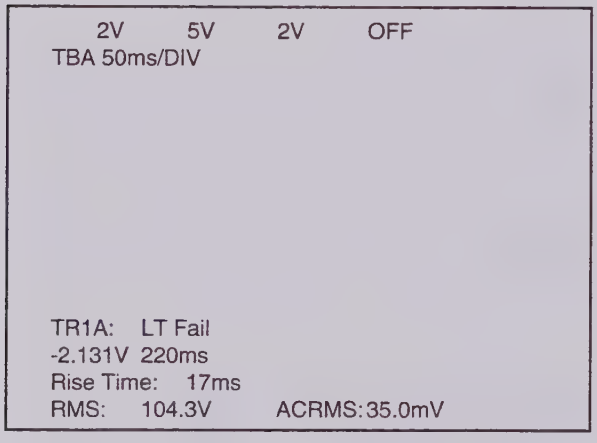


Figure 3.25.1 Example of Calculations on Trace

3.25.2 Top and Base Measurement

The Top & Base selection and some of the other waveform measurements use the results obtained from an automatic Top & Base measurement as defined in the IEEE Standard on Pulse Measurement and Analysis by Objective Techniques: 181-1977.

The result of Top & Base is given in volts.

The IEEE 194-1977 standard defines various parts of a pulse or edge waveform. The DSO's use of these levels and points is shown in figure 3.25.2.

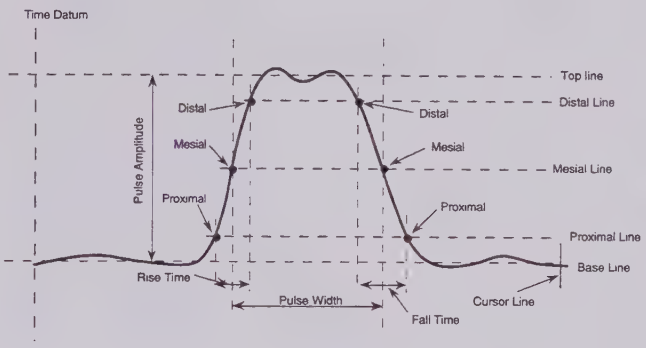


Figure 3.25.2 Waveform Measurement Points

Under most circumstances the Top and Base levels, of a waveform between the time datum and cursor lines, are determined by taking the most common point above the mean of the waveform as the top, and the most common point below the mean as the base.

Two kinds of waveforms can change the method of determining the Top and base.

Firstly, if these points do not occur for more than 10% of the time, the maximum and minimum of the waveform is taken to be the Top and Base. This prevents noisy signals producing erroneous results.

Secondly, if the difference between the mean and the maximum or the mean and the minimum levels of the waveform is less than 1/4 of a division, the maximum and minimum of the waveform is taken to be the Top and Base. This ensures that waveforms such as pulse trains with a low mean do not give erroneous results.

When a measurement that uses the Top and Base levels is selected and the cursor or time datum line is moved or a different trace is selected, the Top and Base levels are alternately shown on the display as solid lines so that the user can see what the subsequent calculations are based upon.

3.25.3 Voltage & Time

In Δ mode, the display shows the voltage between the voltage datum line and the point where the cursor line crosses the trace, and the time between the time datum line and the cursor line.

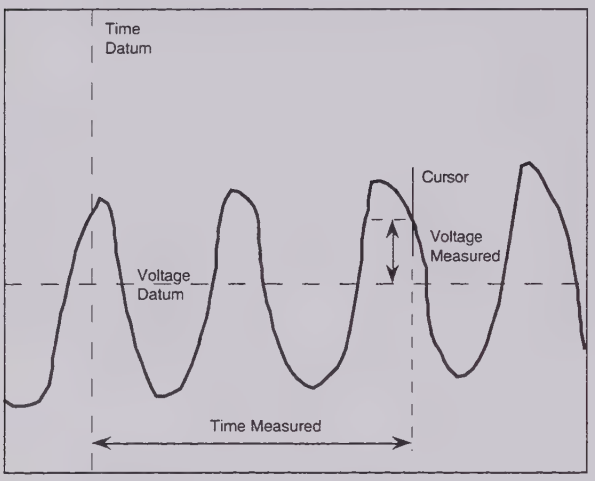


Figure 3.25.3 Voltage and time Measurement

In ABS mode, the display shows the voltage between the channel GND and the point where the cursor line crosses the trace, and the time between the trigger point and the cursor line.

3.25.4 Voltage & 1/Time

In Δ mode the display shows the voltage between the voltage datum line and the point where the cursor line crosses the trace, and the reciprical of the time between the time datum line and the cursor line.

In ABS mode, the display shows the voltage between the channel GND and the point where the cursor line crosses the trace, and the the reciprical of the time between the trigger point and the cursor line.

3.25.5 Peak to Peak

The display will show the peak to peak voltage difference between the most positive and negative points of the trace between the cursor and the time datum. There will be no difference in the displayed result in either ABS or Δ mode.

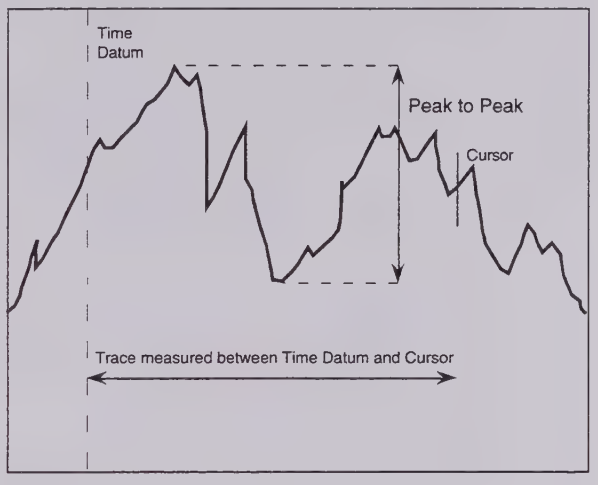


Figure 3.25.5 Peak to Peak Measurement

3.25.6 Max & Min

In Δ mode the display shows the voltages of the maximum and minimum points of the waveform between the cursor and time datum measured with respect to the voltage datum.

In ABS mode the display shows the voltages of the maximum and minimum points of the waveform between the cursor and time datum measured with respect to the channel ground.

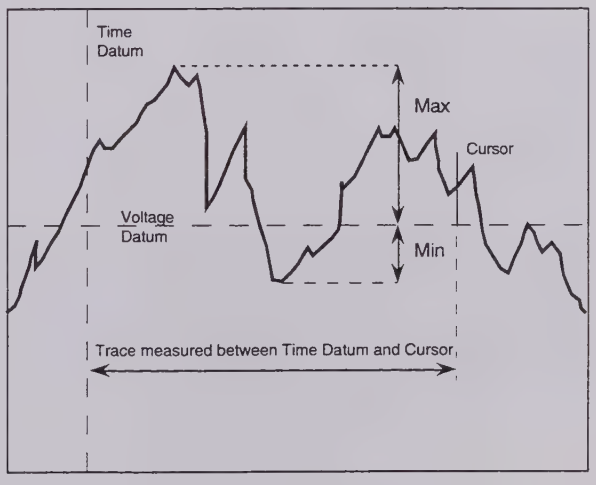


Figure 3.25.6 Max-Min Measurement

3.25.7 Rise and Fall Time

The cursor and the time datum define the rising or falling edge of interest, the edge measured will be the first edge from the left hand side of the defined area.

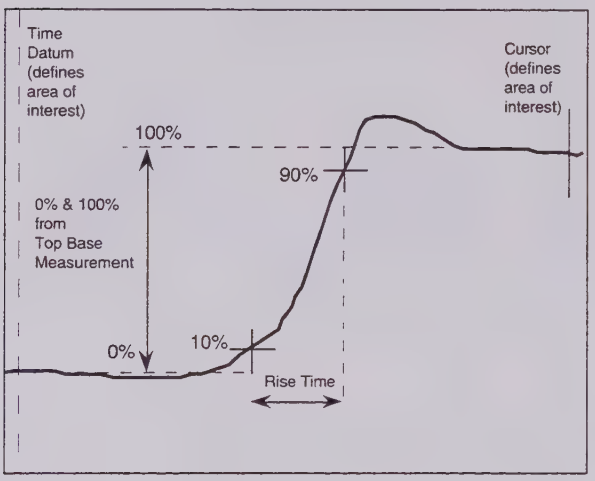


Figure 3.25.7 Risetime Measurement

The software will perform a top & base measurement to determine the 0% and 100% points and then calculate the rise or fall time between the low and high percentage points of the waveform. There will be no difference in the displayed result in either ABS or Δ mode.

When the cursor or the time datum is moved or when a different trace is selected, the top and base lines are flashed alternately on the display for 2 seconds. This allows the user to confirm that the datum and cursor lines are really bracketing the entire area of interest.

The default percentage points are 10% and 90%. Using buttons **6** and **7** on the cursor measurement menu, these values can be changed. Low can be set from 0% to 49% in 1% steps and high from 51% to 100% also in 1% steps.

Percentages set are retained even on power down.

If pulse width is also selected as one of the calculations, pressing button **5** selects between Risetime and Pulse Width.

3.25.8 Overshoot & Preshoot

The cursor and the time datum define the overshoot or preshoot area of interest, the measured result will be the first over or pre shoot voltage from the left hand side of the defined area.

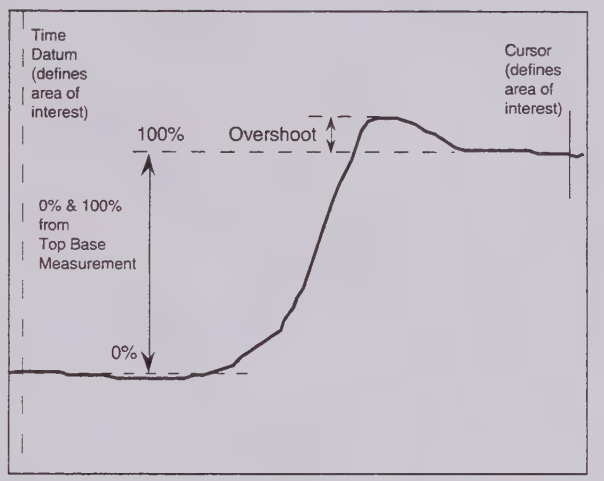


Figure 3.25.8 Overshoot Measurement

The software performs a Top & Base measurement to determine the 0% and 100% points and then calculates the overshoot as a percentage of the voltage difference between the 0% and 100% points. There will be no difference in the displayed result in either ABS or Δ mode.

When the cursor or the time datum is moved or when a different trace is selected, the top and base lines are flashed alternately on the display for 2 seconds. This allows the user to confirm that the datum and cursor lines are really bracketing the entire area of interest.

3.25.9 Pulse Width

The software performs a Top-Base measurement and then measures the time between the 50% - or user defined percentage points of a pulse.

The cursor and the time datum define the pulse to be measured. The first pulse from the left hand side of the defined area will be measured and if the leading edge of this pulse is noisy, the noise may be taken as a pulse and be measured rather than the pulse of interest.

Both positive or negative pulses can be measured. There is no difference in the result of theis calculation in either Abs or Δ modes.

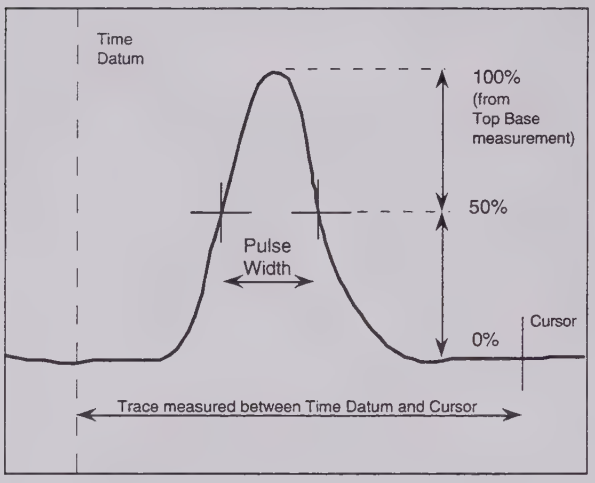


Figure 3.25.9 Pulse Width Measurement

When the cursor or the time datum is moved or when a different trace is selected, the top and base lines are flashed alternately on the display for 2 seconds. This allows the user to confirm that the datum and cursor lines are really bracketing the entire area of interest.

The default percentage points are 50% and 50%. Using buttons **6** and **7** these values can be changed. LEFT refers to the percentage point on the left hand edge of the pulse, this is the rising edge on a positive going pulse. All three options; LEFT RIGHT and LEFT & RIGHT can be set from 5% to 95% in 1% steps.

Percentages set are retained even on power down.

If risetime is also selected as one of the calculations, pressing button 5 selects between Risetime and Pulse Width.

3.25.10 Frequency, Period, Duty Cycle

The three parameters, frequency, period and duty cycle, of a waveform are displayed with this selection. In Δ mode the voltage datum defines the zero crossing voltage. The cursor and time datum must enclose at least three zero crossings. In ABS mode, the voltage datum is fixed to the channel ground and defines the zero crossing points.

If the voltage datum does not cross the trace, the mid point of the waveform between its the top and base levels will be taken as the zero crossing line. This is known as the mesial level. When the mesial level is used, the cursor measurement line includes the word "auto".

The frequency is the inverse of the period calculated above.

The duty cycle is the ratio of the mark or space at the time datum to whole pulse period expressed as a percentage

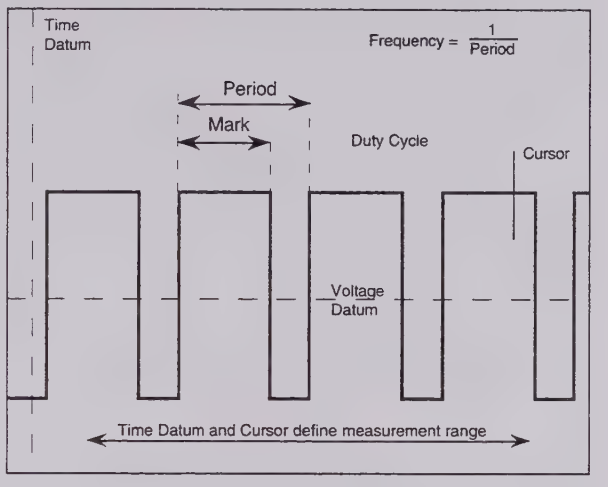


Figure 3.25.10 Freq. Period and Duty Cycle Measurement

3.25.11 RMS & AC RMS

In Δ mode this selection shows both the RMS voltage with respect to the voltage datum and the AC-RMS voltage with respect to the mean of the trace.

In Abs mode this selection shows both the RMS voltage with respect to the voltage datum and the AC-RMS voltage with respect to the mean of the trace.

3.25.12 Area

In Δ mode this selection calculates the area bounded by the trace and the cursor and datum lines. The result is given in volt-seconds or similar units.

If the trace falls below the voltage datum then the area below the datum (area B in figure 3.25.12) will be negative. Positive and negative areas are added algebraically to obtain the displayed result.

In Abs mode this selection calculates the area bounded by the trace, the cursor, the time datum line and the channel ground. The result is given in volt-seconds or similar units.

If the trace falls below channel ground then the area below ground will be negative. Positive and negative areas are added algebraically to obtain the displayed result.

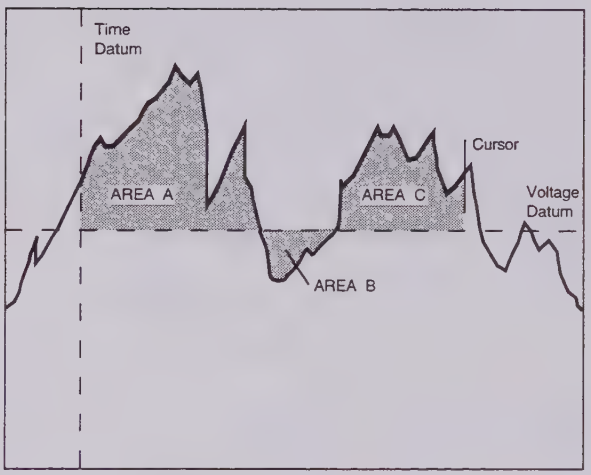


Figure 3.25.12 Area Measurement

3.25.13 Amplitude (Top-Base)

This selection calculates the amplitude of a pulse having first performed a Top & Base measurement. See section 3.25.2. There is no difference in the result of theis calculation in either Abs or Δ modes.

3.26 Trace Manipulation Menu

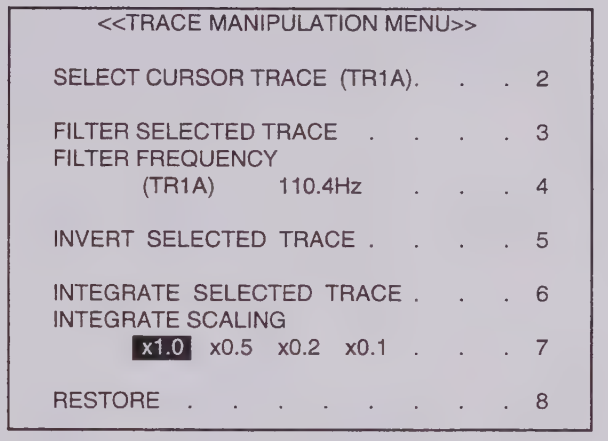


Figure 3.26 Trace Manipulation Menu

When performing any waveform processing that modifies a displayed trace, the new data could be overwritten almost immediately by a fresh acquisition unless the selected trace is held or further acquisitions are prevented e.g. the instrument is in single shot mode and the trace stored. If the instrument is not in this state, the message "SOURCE NOT STORED" will be displayed when the user attempts a trace manipulation.

Trace Manipulation

The trace to be manipulated is selected with the cursor and the required function with button **3** to **7**.

If no trace has the cursor on it when any of the buttons **3** to **7** are pressed, the warning message "NO TRACE SELECTED" will be displayed.

Trace manipulations are with respect to the voltage datum line.

Restore After any trace manipulation has been performed, button **8** will be labelled Restore. Pressing it will return the display to the original stored waveform.

3.26.1 Filter Frequency

The trace can be filtered by a single pole low pass filter and the 3dB point displayed on the trace display.

The frequency of the filter applied to the waveform when button **4** is pressed is selected using button **3**.

One of six filter stages can be chosen from the roll-around list. The actual frequencies available depend on the timebase at which the cursor trace was acquired, as shown in the table below.

Filter Selected Trace: To perform the filtering, press button **4**.

Invert Selected Trace: If button **5** is pressed, the selected trace will be inverted about the voltage datum. The original trace can be 'Restored' using button **8**. Any cursor measurements will be made on the inverted waveform.

Integrate Scaling: To allow an integrated waveform to fit on the screen a scaling factor can be applied to the integrate function. Pressing button **6** steps around the factors ×1, ×0.5, ×0.2 and ×0.1. The selected factor is highlighted.

Integrate Selected Trace: When button **7** is pressed, the display will show the integrated waveform of the selected trace. The voltage datum is taken as zero for integration and the cursor reads out the value of the area under the original curve between the time datum and the cursor in Vs - volt-seconds - or similar units.

Timebase	F1	F2	F3	F4	F5	F6
50s	110.4mHz	45.8mHz	21.2mHz	10.28mHz	5.06mHz	2.5mHz
20s	278mHz	114mHz	53.2mHz	25.8mHz	12.6mHz	6.27mHz
10s	552mHz	229mHz	106mHz	51.4mHz	25.3mHz	12.5mHz
5s	1.104Hz	458mHz	213mHz	102.8mHz	50.6mHz	25mHz
2s	2.208Hz	1.14Hz	532mHz	258mHz	126mHz	62.7mHz
1s	5.52Hz	2.29Hz	1.06Hz	514mHz	253mHz	125mHz
500ms	11.04Hz	4.58Hz	2.12Hz	1.028Hz	506mHz	250mHz
200ms	22.08Hz	11.4Hz	5.32Hz	2.58Hz	1.26Hz	627mHz
100ms	55.2Hz	22.9Hz	10.6Hz	5.14Hz	2.53Hz	1.25Hz
50ms	110.4Hz	45.8Hz	21.2Hz	10.28Hz	5.06Hz	2.5Hz
20ms	220.8Hz	114Hz	53.2Hz	25.8Hz	12.6Hz	6.27Hz
10ms	552Hz	229Hz	106Hz	51.4Hz	25.3Hz	12.5Hz
5ms	1.104kHz	458Hz	212Hz	102.8Hz	50.6Hz	25Hz
2ms	2.208kHz	1.14kHz	532Hz	258Hz	126Hz	62.7Hz
1ms	5.52kHz	2.29kHz	1.06kHz	514Hz	253Hz	125Hz
500µs	11.04kHz	4.58kHz	2.12kHz	1.028kHz	506Hz	250Hz
200µs	22.08kHz	11.4kHz	5.32kHz	2.58kHz	1.26kHz	627Hz
100µs	55.2kHz	22.9kHz	10.6kHz	5.14kHz	2.53kHz	1.25kHz
50µs	110.4kHz	45.8kHz	21.2kHz	10.28kHz	5.06kHz	2.5kHz
20µs	220.8kHz	114kHz	53.2kHz	25.8kHz	12.6kHz	6.27kHz
10µs	552kHz	229kHz	106kHz	51.4kHz	25.3kHz	12.5kHz
5µs	1.104MHz	458kHz	213kHz	102.8kHz	50.6kHz	25kHz
2µs	2.208MHz	1.14MHz	532kHz	258kHz	126kHz	62.7kHz
1µs	5.52MHz	2.29MHz	1.06MHz	514kHz	253kHz	125kHz
500ns	11.04MHz	4.58MHz	2.12MHz	1.028MHz	506kHz	250kHz
250ns	22.08MHz	9.16MHz	4.24MHz	2.056MHz	1.012MHz	500kHz
125ns	44.1MHz	18.3MHz	8.4MHz	4.11MHz	2.02MHz	1MHz
100ns	55.2MHz	22.9MHz	10.6MHz	5.14MHz	2.53MHz	1.25MHz
50ns	110.4MHz	45.8MHz	21.2MHz	10.28MHz	5.06MHz	2.50MHz
20ns	220.8MHz	114MHz	53.2MHz	25.8MHz	12.6MHz	6.27MHz

Table 3.26. Filter Frequencies

3.27 Trace Math Menu

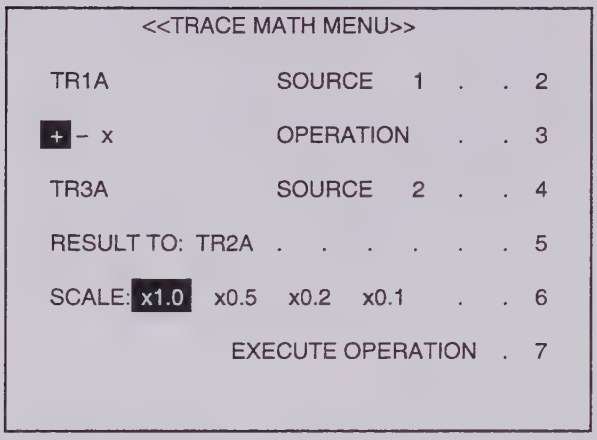


Figure 3.30 Trace Math Menu

Source and Operation: Using buttons 2, 3 and 4 the traces involved and the calculation required can be chosen with the selected option being highlighted.

Result to: The result of the arithmetic will be stored and or displayed in this trace and is selected with button **5**.

Scale: When multiply is selected as the operation, the scale line next to button **6** appears so that a scale factor can be applied to the calculation result to allow it to fit on the screen

Execute Operation: Pressing button **7** - Execute - performs the selected calculation.

3.28 Test Limits Menu

This menu is most easily used superimposed on the trace display by setting transparency ON in the Display Master Menu. See section 3.9.2

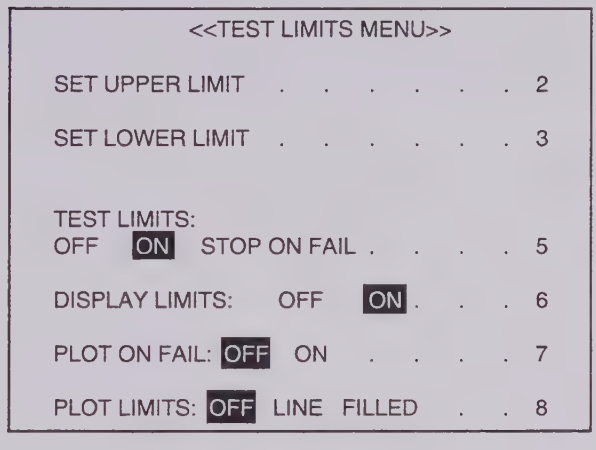


Figure 3.28 Limits Testing Menu

SET UPPER and LOWER LIMITS: The upper and lower limits to be tested against are set by displaying the desired limit trace on the screen, selecting the desired trace with the cursors and then pressing either button **2** or **3** as required. When a limit has been set, the message LIMIT SET is briefly displayed at the bottom of the screen.

If Display Limits is turned On using button **6**, the limit traces will be displayed and the band between the upper and lower limits will be shaded.

Limits testing will be performed on all the data points of both the upper and lower limit traces within the area bounded by the cursor and time datum lines.

Limit testing may be turned On or Off or set to Stop on Fail by pressing button **5**. When turned On, each successive acquisition is tested and a warning message displayed when a trace is outside the limits. This warning and trace will be overwritten by the next acquisition.

If the limits mode is set to Stop on Fail, acquisitions are halted when a trace that is outside the limits is captured, allowing it to be examined. This screen picture can be plotted, and with the internal color or thermal plotter, the area between the upper and lower limits can be shown filled with vertical lines.

Test Limits only operates when the DSO is in Refresh mode and Display Limits cannot be turned on if the DSO is in X-Y mode. If Limits testing is selected when the instrument is not in refresh mode, an error message will be displayed. If X-Y

mode is selected while Display Limits is on, the limit traces are turned off.

A record of all failing traces can be automatically plotted by setting the limits testing mode to stop on fail, and selecting Auto Plot from the plotter menu. Any acquired trace that then falls outside the limits will be plotted. If the plot button is not pressed to initiate a continuous sequence, only the first failing trace will be acquired and plotted.

3.29 Averaging Menu

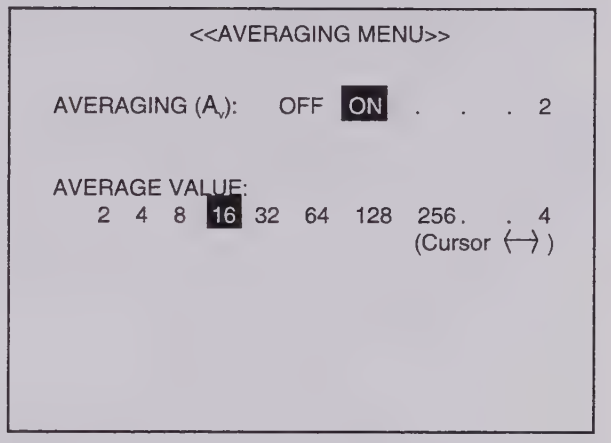


Figure 3.29 Averaging Menu

Averaging It is possible to improve the signal to noise ratio of repetitive signals by averaging them. Averaging is switched On or Off by pressing button **2**.

When averaging is turned on, the A_v symbol will appear at the upper right hand side of the trace display.

If the instrument is in continuous mode, this function converts the display into a weighted average of previous acquisitions. Button **4** selects the averaging factor used in the algorithm:-

$$A_n = \frac{a_n\,(f-1) + d}{f}$$

Where:

n	=	The data point (1 to 501)
A_n	=	New value at n
a_n	=	Old value at n
f	=	Averaging factor (2 to 256)
d	=	Latest value at n

e.g. In continuous mode, if 8 acquisitions are selected, any single acquisition that deviates from an otherwise consistent level, contributes 1/8 of its deviation to the display.

If the instrument is in S/Shot mode, only the number of acquisitions selected by button **4** contribute to the resultant, unweighted, held display, i.e. true averaging.

4. Performance Checking

The aim of this section is to allow the DSO user to verify the major analog performance parameters. Should any of these fail to be within specification, then it is recommended that the instrument be re-calibrated. Return the instrument to your local Gould distributor; alternatively, a skilled technician with the aid of the service manual will be able to perform this task.

Instead of using a 50Ω terminator where directed in the following sections, the instrument can be set to 50Ω input impedance using the menu system. See section 3.3

4.1 Bandwidth

Equipment Required:

Leveled signal generator: Tektronix SG503 or similar;

50 Ohm coaxial cable;

50 Ohm terminator;

Connect the signal generator to a channel input (set to 1MΩ) through the coax cable and the terminator - which should be at the instrument end of the cable.

1. Select 10mV per division on the input channel and set the timebase to 50µs per division.
2. Set the amplitude of the signal generator to give six divisions at 50kHz or similar reference frequency.
3. Increase the frequency of the signal generator until the peak to peak amplitude reduces to 4.2 divisions.

The measured frequency should be greater than 100Mz.

4.2 Trigger sensitivity

Equipment Required:

Signal generator: Tektronix SG503 or similar;

50 Ohm coaxial cable;

50 Ohm Terminator;

Connect the signal generator to a channel input (set to 1MΩ) through the coax cable and the terminator - which should be at the instrument end of the cable.

1. Select 100mV per division on the input channel and set the timebase to 50µs per division.
2. Select **Auto** trigger.
3. Set the signal generator to 50kHz or similar reference frequency and adjust the amplitude to give 3mm peak to peak.
4. Select **AC** coupling and **Norm** on the trigger controls.

It should now be possible to find a suitable trigger level to obtain a stable picture.

4.3 Trigger Bandwidth

Equipment Required:

Leveled signal generator: Tektronix SG503 or similar.

50 Ohm coaxial cable;

50 Ohm terminator;

Connect the signal generator to a channel input (set to 1MΩ) through the coax cable and the terminator - which should be at the instrument end of the cable.

1. Select 100mV per division on the input channel and set the timebase to 50µs per division.
2. Set the amplitude of the signal generator to give three divisions at 50kHz or similar reference frequency.
3. Select **AC** coupling and **Norm** on the trigger controls.
4. Without adjusting its amplitude, set the signal generator to 100MHz

It should be possible to adjust the trigger level to give a stable trace.

4.4 Timebase Calibration

Equipment required:

Time calibrator: Bradley oscilloscope calibrator type 192 , Tektronix TG501 or similar;

50 Ohm coaxial cable;

50 Ohm terminator;

Connect the signal generator to a channel input (set to 1MΩ) through the coax cable and the terminator - which should be at the instrument end of the cable.

1. Set the calibrator to produce markers every 50µs.
2. Set the timebase to 50µs per division and set the channel attenuator to give between two and five vertical divisions of signal.
2. Set **DC** coupling and **Norm** on the trigger controls.
3. Adjust the trigger level to give a stable trace.
4. Select the cursors.

With the time datum and the cursor on identical positions on any two different markers, the time difference should read in multiples of 50µs to within 0.1%.

Note: *Failure of this specification point is indicative of a major system fault and the instrument should be serviced immediately.*

4.5 Vertical Calibration

Equipment required:

Oscilloscope calibrator: Bradley type 192 or similar;

Coaxial cable;

Connect the vertical calibration output of the oscilloscope calibrator to a channel input, which must be set to 1MΩ, through the coax cable.

1. Set the timebase to 500µs per division and select 10mV per division for the input channel.
2. Set the calibrator to give 50mV peak to peak, i.e. 5 screen divisions.
3. Adjust the trigger level to give a stable picture.
4. Switch the cursors on.

The peak to peak measurement should be 50mV to within 2%±1 LSB and the trace should be 5 divisions high to within ±0.1 divisions.

These measurements should be repeated on all the attenuator ranges, each time setting the calibrator to 5 screen divisions for the selected range.

4.6 Glitch Detect (Alias Detection)

Equipment required:

Signal generator: Tektronix SG503 or similar;

50 Ohm coaxial cable;

50 Ohm terminator;

Connect the signal generator to a channel input (set to 1MΩ) through the coax cable and the terminator - which should be at the instrument end of the cable.

1. Set the timebase to 100µs per division and select 100mV per division on the input channel.
2. Set the generator to give approximately 5 divisions at 10kHz and adjust the trigger level to give a stable trace.
3. Select 10ms per division on the timebase. You should notice that the screen picture will change considerably with small changes in input frequency.
4. Carefully adjust the frequency of the signal generator to produce a sine wave of approximately 2 to 5 cycles. This is an alias.
5. Turn on the MAX/MIN glitch detect function in the Acquisition/Trigger Menu.

If the glitch detect is functioning correctly, then two roughly horizontal lines should be displayed. These will be at the maximum and minimum peak levels of the signal.

5.0 INTERFACE OPTIONS

There are two interface options available for the instrument:

An RS423 interface pod; option 102A and a GPIB interface pod; option 103A.

Each of the pods fits to the rear panel of the instrument. Only one can be fitted at any one time. Once fitted, the pod's features can be controlled through the instrument's menu system.

5.1 Plotters/Output Devices

Various plotters can be controlled by the DSO to provide permanent records of acquired traces and instrument set-ups. An internal four color plotter and an internal thermal plotter are available and external plotters can be connected to either the RS423 or GPIB interface pods.

5.1.1 Thermal Plotter

The internal thermal plotter for the instrument is a factory fitted option and is located in the top cover. It adds only 2.5mm to the overall height of the instrument. Its operation is detailed in sections 2.6.2 and 3.14 of this manual.

5.1.2 Color Plotter

The internal color plotter for the instrument is a factory fitted option and is located in the top cover. It adds only 2.5mm to the overall height of the instrument. Its operation is detailed in sections 2.6.1 and 3.14 of this manual.

5.1.3 RS423 and GPIB Plotting

Plots can be sent to an external plotter via either the RS423 serial bus or the GPIB parallel bus. Details of cable requirements for RS423 interfacing and instructions for plotting to an external plotter are given in section 3.7.

Both interfaces communicate with plotters using the standard HPGL command set.

5.2 Communication via GPIB/RS423

This section of the operators manual introduces the concepts of GPIB and RS423 communication and explains in detail the command set.

There are four basic operations that can be performed with a controller and the DSO through an interface:

Set up the instrument and make waveform measurements

Retrieve setup information and measurement results

Send captured waveform data to the controller

Return previously transferred waveforms to the scope

Other more complicated tasks can be accomplished by combining these four building blocks.

Both the GPIB and the RS423 interface options are very versatile allowing fast communication between a host computer and the DSO. The options are mutually exclusive, i.e. only one can be used at any one time.

The two ports are electrically different, but the communication format is essentially the same in either case.

Except where indicated this section applies to both GPIB and RS423 operation.

5

5.2.1 GPIB (IEEE-488)

This is a parallel bus interface allowing communication between a host computer and up to 30 peripherals. It is based on the controller/talker/listener structure whereby the controller - usually the host computer - commands various peripherals to 'talk' or 'listen' according to the desired data path. Each peripheral on the bus is assigned a unique address number and on the DSO this is set via the GPIB interface menu -section 3.10.

There are three main modes of operation of the GPIB:

Local: The operator has full control of the instrument via the front panel. The DSO may be interrogated but not manipulated in any way by the host computer.

Remote: All the DSO's GPIB commands can be used in this mode. The only front panel control that operates in this mode is the abort button (47) which when pressed, returns the instrument to local mode.

Remote with Local Lock Out: This is an extension of the Remote mode. None of the instrument's front panel controls operate except the power on/off switch.

The connections to the GPIB are listed below. For further details of the connector see Appendix 5.

Pin	Signal	Description	
1	DIO1	Data input output line 1	
2	DIO2	Data input output line 2	
3	DIO3	Data input output line 3	
4	DIO4	Data input output line 4	
13	DIO5	Data input output line 5	
14	DIO6	Data input output line 6	
15	DIO7	Data input output line 7	
16	DIO8	Data input output line 8	
5	EOI	End Or Identify	Interface Management Lines
17	REN	Remote Enable	
9	IFC	Interface Clear	
10	SRQ	Service Request	
11	ATN	Attention	
6	DAV	Data Valid	Handshake Lines
7	NRFD	Not ready for data	
8	NDAC	Data not accepted	
18	(DAV)		Return lines Twisted With same name line
19	(NRFD)		
20	(NDAC)		
21	(IFC)		
22	(SRQ)		
23	(ATN)		
12	Shield		
24	Logic Ground		

Table 5.2a GPIB IEEE-488 pin connections

Protocols

The protocols of IEEE 488.2 define the overall structure of the communication process, when devices should talk or listen and what happens when protocols are not followed.

Elements

Input Buffer The input buffer of the DSO is the memory area where commands and queries are stored prior to being parsed and actioned. This allows the controller to send a string of commands to the DSO which can then be parsed and actioned by the instrument while the controller is performing other tasks such as talking to another instrument. The DSO's input buffer will hold 512 bytes of data, although the DSO is capable of handling block data greater than this where appropriate.

Output Queue The output queue of the DSO is the memory area where all output data is stored until read by the controller. The DSO's output queue will hold 512 bytes of data, although the DSO is capable of handling block data greater than this where appropriate.

Parser The parser is the name given to the software which interprets commands sent to the DSO and determines the appropriate actions. Parsing means the action taken by the parser to action a command.

Protocol operation

Each time the instrument is powered up or when it receives a device clear command, the input and output buffers are cleared, and the parser is reset to the root level of the command tree see figure 5.3.

The DSO and the controller communicate using program messages and response messages. Program messages are sent by the controller to the DSO and response messages are sent to the controller from the DSO in response to a query message. A query message is a program message that contains one or more queries.

The DSO can only talk in response to a valid query message. i.e. when it has something to say. The controller should always read a response before sending another program message.

Protocol errors

Addressed to talk with nothing to say If the DSO is addressed to talk before it has received a query, it will indicate a query error and will not send any bytes over the bus. If the DSO has nothing to say because of an error during a query execution the instrument will not indicate a query error but simply wait to receive the next transmission from the controller.

Addressed to talk with no listeners on the bus If the DSO is addressed to talk while there are no listening devices on the bus the DSO will wait for a device to listen or for the controller to take control.

Command error A command error will be reported if the instrument detects a syntax error or an unrecognized command.

Execution Error An execution error will be reported if a parameter is found to be out of range, or if the current instrument settings are not suitable for the requested command or query.

Device Specific Error A device specific error will be reported if the instrument is unable to execute a device dependent command.

Query Error A query error will be reported if the proper protocol for reading a query is not followed. A query error will also be generated by an unterminated and interrupted message as detailed below.

Unterminated Condition A query error will be generated if the controller attempts to read a response message before terminating the program message. If this occurs, the parser will be reset and the response will be cleared from the DSO's output queue. The response will not be sent over the bus.

Interrupted condition A query error will be generated if the controller attempts to send a program message before reading the entire response message to a previous query. The unread part of the response is lost but the new program message will not be affected.

Buffer Deadlock If the DSO's input and output queues both become full a buffer deadlock may occur. This is only likely to happen if a very long program message containing queries that result in a lot of response data is sent to the DSO. The input buffer will become full so that the entire programme message cannot be sent but the controller cannot read any of the response data until it has finished sending the program message; a deadlock.

If this situation occurs, the DSO will clear the output queue, thus breaking the deadlock, and it will continue to clear the responses until the end of the current program message. The query error bit will be set by this condition.

5.2.2 RS423

The RS423 interface is an updated form of the RS232 standard and is a serial connection requiring a dedicated input and output on the host computer to each peripheral.

RS423 uses lower voltages and lower impedances than RS232 but is electrically compatible.

Occasionally problems can be encountered with RS423 cabling. These difficulties are almost always resolved by correct connection of the data and handshake lines to ensure the correct direction of signal travel.

Some of the commands on the DSO are special IEEE488.2 commands and as such are meaningless on RS423. For compatibility however, assertive commands are always accepted by the DSO but those that are non RS423 will have no action. Non RS423 queries will return 0.

The RS423 connections on the interface for the DSO are listed below. For further details of the connectors see Appendix 5.

Interface 1 (Plotter)			Interface 2 (Bi-Directional Control)
Pin	**Signal**	**Description**	**Pin**
1	0V	Protective Ground	1
2	RXD	Receive Data	3
3	TXD	Transmit Data	2
4	RTS	Request to Send	4
5	CTS	Clear to Send	5
6	DSR	Data Set Ready	6
7	0V	Signal Ground	7
8	DCD	Data Carrier Detect	8
9	True	RS423 Logic True	9
14	True	RS423 Logic True	14
20	DTR	Data Terminal Ready	20

Table 5.2b RS423 Pin Connections

5.2.3 About GPIB and RS423 Commands

The commands of the DSO are simple and English-like. Where necessary, mnemonics have been used to replace large words or text.

Commands can be sent to the instrument as a combination of upper or lower case characters but the instrument always responds in uppercase.

Commands and queries may be sent in either the long (complete spelling) or short (abbreviated spelling) form. In the command descriptions the short form is indicated by the uppercase characters and the long form by all the characters. The characters shown in uppercase must be used. Some or all of the lowercase characters can be used, in addition, at the user's discretion.

Programs written using the long form of commands are more easily read and understood. The shortform uses less memory storage and is faster as less data has to be transmitted.

As an example of commands, the following all set channel 1 to an input sensitivity of 50mV/Div

:CHANNEL1:RANGE 50E-3

:CHANNE1:RANG 50E-3

:CHAN1:RANG 50E-3

Multiple commands and queries can be sent on the same line by separating each command with a semi-colon.

:CHAN1:RANG 50E-3;:DISP:HOLDALL ON

Some commands have various options associated with them e.g. the Channel command is followed by the channel number that it refers to. Where these various options are

compulsory they are enclosed in curly brackets: { } each option is separated by a vertical line: | This means that one and only one of the items within the curly brackets must be included in the command. Some commands may have more than one set of curly brackets, in which case one item from each set must be used.

Where the command is a simple on off function, numeric data may be used instead of Off or On. Zero stands for OFF and any other number stands for ON. In these cases the individual command descriptions detail the meaning of Zero and non zero values.

In this manual the following conventions and abbreviations are used:

<cr> is used to represent the carriage return control code.
<lf> is used to represent the line feed control code.
{} denotes an item that must be included in the command.
| separates options within {}.
EOI stands for: End Or Identify. (GPIB signal line).
numeric means that a number is taken as the argument of the command.
* Means either the whole set i.e. all channels, or can be replaced by a single member of the set e.g. CHAN1.

5

Interface Capabilities

The interface capabilities of the DSO, as defined by IEEE 488.1 are SH1, AH1, T5, L4, SR1, RL1, DC1, C0, E2, PP0 and DT0

Concepts

The GPIB bus has two modes of operation: Command mode and Data mode.

The bus is in Command mode when the ATN line is high and in Data mode when ATN is low.

The Data mode is used to send device dependant messages which include all the commands and queries detailed in section 5.3.2.

The command mode is used to send talk and listen addresses and the following bus commands

DCL Device Clear; Clears input and output buffers, resets the parser and clears any outstanding commands

SDC Selected Device Clear; Clears input and output buffers, resets the parser and clears any outstanding commands

GET Group Execute Trigger command: causes the DSO to arm.

IFC Interface Clear; Halts all bus activity, un addresses all devices and returns control to the controller.

5.2.4 About Common Commands

The common commands are defined in the 488.2 standard and are common to all instruments complying with this standard. The common commands are used to control some of the DSO's basic functions such as instrument identification and reset and the status reporting and clearing.

Numbers

Numbers that appear in commands must conform to certain conditions:

- The number must contain less than 20 characters,
- The mantissa may contain a sign (+/-), + will be assumed if none is specified,
- The exponent is optional, if included it must be preceded by an 'E' or 'e',
- The exponent may contain a sign (+ or -), if omitted + is assumed.

Numbers transmitted by the DSO will, in addition to the above constraints, use engineering notation.

The DSO will accept and buffer characters from the bus until a correctly terminated record is completed or until the buffer overflows.

Command Types

There are two types of command:

Query: This is a request for the current setting of a control or the current contents of a memory to be transmitted. The instrument responds by sending an appropriate record. e.g sending TIME? will result in a record of the form

TIME {numeric,numeric,numeric}

being sent back.

Command: This requests that a setting or the contents of a memory be changed. Commands are always in the form 'parameter setting'. e.g TIME 12,36,59 will set the time to 36 minutes 59 seconds past 12 o'clock.

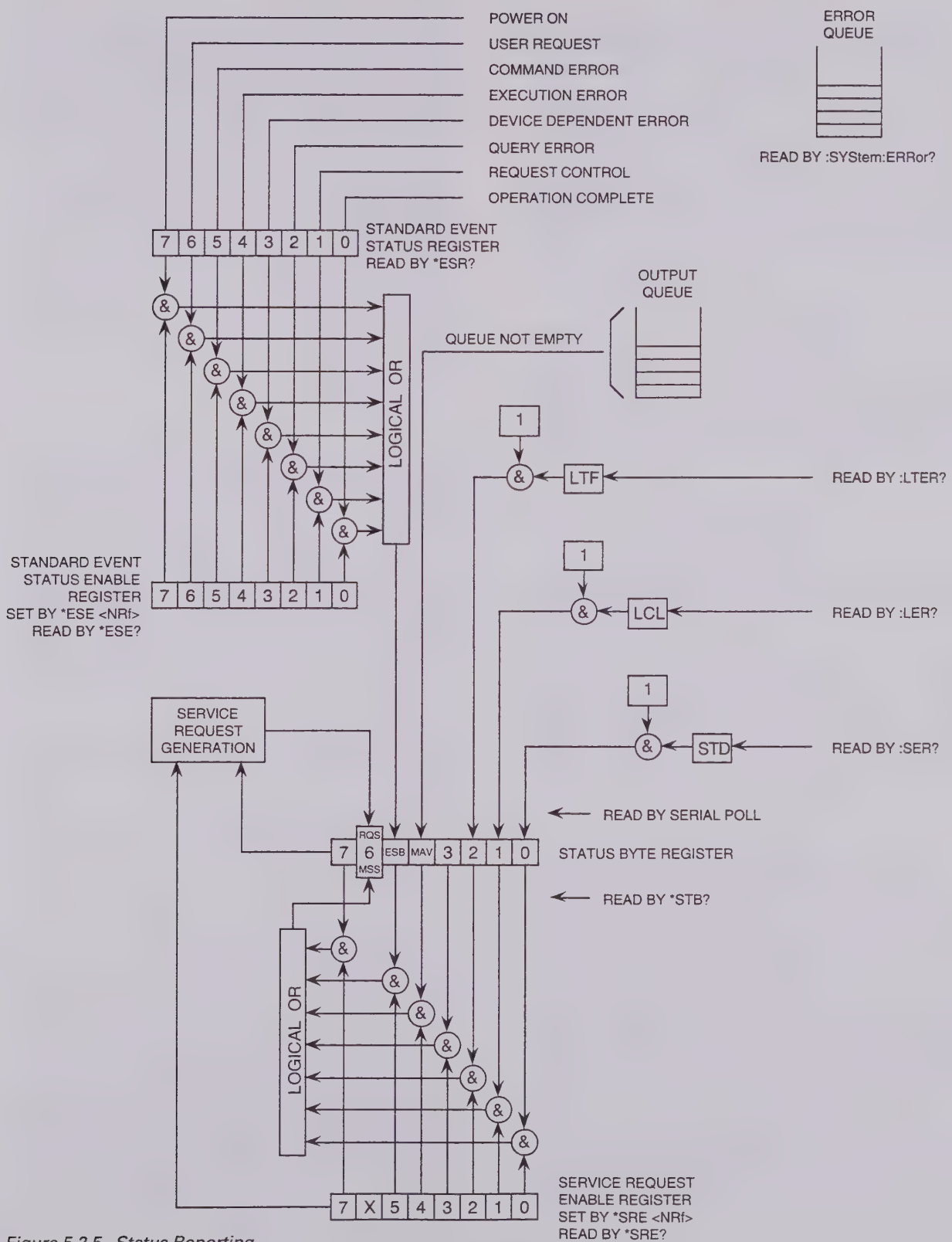


Figure 5.2.5 Status Reporting

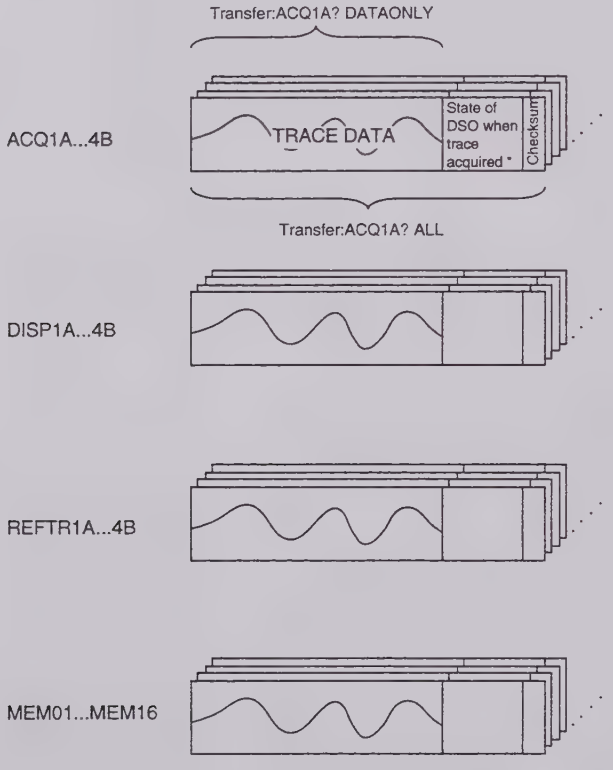
Note: *Commands are only valid when the instrument is in Remote mode. If an command is received when the instrument is in local, the DSO will enter remote mode.*

5.2.5 Status Reporting

Status registers keep a note of the current instrument status. By examining the status registers, the user can find out whether an operation has been completed, whether a command has caused an error and other information about the instrument. See figure 5.2 for the contents and names of the status bytes on the DSO.

5.2.6 Bulk Transfers

Bulk transfers were devised to allow a remote user to send or receive either trace or instrument set-up data. In particular, transfers out of the instrument allow useful or important traces and instrument set-ups to be saved on an external storage device, such as a PC. Transfers into the scope allow the this saved information to be recalled, or, in the case of trace transfers, custom traces to be created.



* Data essential for the DSO operation if a trace is transferred back to the instrument so that measurements will be meaningful

Figure 5.2.6 Trace Transfer Configuration

This latter point highlights an important difference between trace and set-up transfers. Instrument set-up transfers are provided only as a means of backing up and restoring useful set-ups. It is not possible to make up custom, transferable set-ups on, say, a PC, then transmit them to the instrument since the meaning of the values transmitted and stored as part of a set-up is only understandable by the DSO.

The Commands used for data transfers are shown below. For details of the command syntax and usage see the appropriate entry in the command detail section.

TRACE TRANSFERS	SET-UP TRANSFERS
:TRANsfer:ACQuisition	:TRANsfer:SETup
:TRANsfer:DISPlay	
:TRANsfer:REFerenceTRace	
:TRANsfer:MEMory	
:TRANsfer:LIMIT:UPper	
:LOWer	

The data transmitted between the DSO and controller consists of two distinct parts. A header giving information about the destination or source of the following trace or setup data, and the trace or set-up data itself.

In the case of transfers from the DSO to a controller the header is optional and can be disabled or enabled using the :SYS:HEADER {OFF|ON} command. If a set-up is received by a controller without a header, a suitable header can be created prior to sending the set-up data back to the DSO.

Trace Transfers

Trace transfers fall into 5 categories based on the source or destination of the data.

ACQuisition transfers send and receive data that has been acquired by the DSO

DISPlay transfers send and receive data that is being displayed on the screen

REFerenceTRace transfers send and receive data stored in the DSO's reference traces

MEMory transfers send and receive data stored in the DSO's memories

LIMIT transfers send and receive the data used and displayed in the DSO's LIMITS TESTING function.

It is important to understand the difference between ACQuisition and DISPlay transfers. ACQuisition transfer send or receive data acquired by the DSO, DISPlay transfers send and receive data currently being displayed by the DSO.

Under normal circumstances these two are one and the same, as the DSO normally displays the data it is acquiring. However, with an XMAG of 2, 5 or 10 the DSO displays a smaller portion of the data being acquired. In this case, ACQuisition transfers will transfer data as before, but DISPlay transfers will send or receive the *displayed trace data*, i.e. the expanded section of trace that appears on the screen. Similarly, if a REFerenceTRace is selected to replace a live trace, then ACQuisition transfers will transfer data as before (the data being acquired by the DSO), and DISPlay transfers will send or receive the data being displayed, i.e. the REFerenceTRace data.

Furthermore, the ACQuisition, DISPlay, REFerenceTRace and MEMory transfers can be in one of two forms; ALL or DATAonly.

ALL type transfers.

The 'trace data' transmitted by the DSO consists of 3 parts. Firstly approximately 500 data bytes that represent the points on the screen. This is followed immediately by a series of data bytes which contain information about the instrument settings at the time the trace was acquired. The third and final part is data used to check the integrity of these instrument settings. Any errors in this data will cause the scope to reject the entire transfer.

ALL type transfers are approximately twice the length of DATAonly transfers (approximately 1k bytes in raw format.)

The TRANsfer:WindowSTArt and TRANsfer:Window STOp functions described below have no effect on ALL type transfers.

ALL type transfers are designed to provide a way of archiving and restoring all information about the requested trace.

DATAonly transfers

Contain only bytes of data representing the trace as displayed on the screen. In this mode the TRANsfer:WindowSTArt and TRANsfer:WindowSTOp functions described below come into effect to define the portion of the traces to transfer.

DATAonly transfers are designed to provide a quick and flexible way of transfering trace data. They are quicker than ALL type transfers because there will always be less data to transmit, even if the TRANsfer:Window parameters are set to select all 501 points on screen.

However, the state of the DSO is not included in this transfer. Thus, when a DATAonly transfer is used to send trace data to a destination trace, the DSO will use the information associated with the original destination trace in order to make measurements.

LIMIT:UPPER and LIMIT:LOWER transfers are always DATAonly type transfers.

Default Transfers

By default as transfers are DATAonly. This means it is not necessary to specify 'DATAonly' as part of the command, i.e. the two queries

TRANSFER:ACQ1A? and

TRANSFER:ACQ1A:DATAONLY?

are identical.

:TRANsfer:LIMIT transfers are always DATAonly and therefore 'DATAonly' should not be specified as part of the corresponding command.

DSO To Controller Transfer Failures

Under normal circumstances the DSO will send out exactly the data requested by a controller. However, with MEMory, REFerenceTRace and SETup transfers the corresponding requested data may not be valid.

For example, if instrument setup no. 6 has never been used, the command TRANSFER:SETUP6? is invalid. The same is true of unused MEMories and REFerenceTRaces. If such a request is made of the DSO it will a) report an error in the usual way, and b) send to the controller the expected number of bytes of data, all of which will be zeros.

DATAonly Transfer Windows

With DATAonly transfers the DSO provides the facility to transfer any subsection of any trace, to and from the instrument. This can be useful if, say, only the center 4 divisions of a trace are of interest. Clearly transfers will complete faster if less trace data is requested or sent.

The section of the trace to be transferred is defined using the TRANsfer:WindowSTArt and TRANsfer:Window STOp commands. Remembering that there are 50 sampled points per division, the center 4 divisions would be selected as follows.

TRANsfer:WindowSTArt 150; WindowSTOp 349

Transfers to and from the DSO will now be restricted to the 200 points in the center of the trace.

Sending the command:

TRANsfer:WindowSTArt 250; WindowSTOp 449

will select divisions 5 to 9 inclusive, and data transmitted to the DSO in DATAonly mode will appear in that position on the screen.

One of the most common errors encountered when transferring data to and from the DSO is an unexpectedly short transfer. This is often the case when the transfer window required has not explicitly set. In general, the transfer window should be set to the required value prior to performing transfers rather than assuming that the DSO was last used with the required window.

Textual and Binary (raw) Transfer Formats

Having discussed 'what' data can be transmitted to and from the DSO it is now necessary to define the form of the transfers. Trace or set-up data can be transmitted by the instrument in two forms.

Textual transfers consist of ASCII letters and numbers alone, that is they are in a human readable form. For example, a trace acquired by the instrument may start low and rise within the first few samples. In this case the data output by the instrument would be of the form,

12,100,175,180,185,

and so on. As can be seen this is easily readable, but has the disadvantage that up to 4 ASCII characters are sent for each sample point in the source trace. Naturally this makes the transfer time longer.

If a transfer header is produced by the DSO or controller it will always be in an ASCII (human readable) form. Any user generated traces must also have the header in ASCII form.

Transfer Radix

For textual transfers from DSO to controller it is possible to select the number base used by the DSO instrument when converting the source trace data into ASCII. The factory set default radix is DECIMAL as shown above. HEXADECIMAL or OCTAL can also be selected, which would produce the following output for the example above,

#HC,#H64,#HAF,#HB4,#HB9

#Q14,#Q144,#Q257,#Q264,#Q271

In general, hexadecimal transfers are longer than decimal transfers and octal transfers are longer than hexadecimal transfers. The ability to generate values in different number bases allows the recipient of the data greater flexibility when attempting to decode the trace transfer into a usable form.

For textual transfers from a controller to the DSO, a mixture of DECIMAL, HEXADECIMAL and OCTAL is acceptable. Thus,

12,#H64,175,#Q264,#HB9

will be accepted by the DSO and will be translated into the same trace data as the three previous examples.

During textual transfers the data transmitted must conform to the IEEE standards for <DECIMAL PROGRAM DATA> or <NON-DECIMAL PROGRAM DATA>.

Binary Transfers

The advantage of binary transfers over textual transfers is their speed. Each item of data transferred is sent as an 8 bit value. Apart from the overhead of the header, there is a one to one relationship between the length of data requested (see TRANSFER WINDOWS above) and the number of bytes sent. Effectively, trace or set-up data from the DSO is transferred to a controller without translation to ASCII text format first.

This type of transfer is incompatible with RS423 communications with XON/XOFF handshaking because the special control characters used to implement XON/XOFF can appear as part of the trace or set-up data, causing the transfer to fail. Either RTS/CTS handshaking or textual transfers should be used instead.

The data part of a binary/raw transfer consists of four items.

1) a single '#' character
2) a single character selected from '1', '2' ... '9' which specifies the length of part 3)
3) 1 to 9 characters which make define the number of bytes of data to follow
4) up to 999,999,999 bytes of data

In practice the DSO will only transmit and receive between 1 and 999 bytes of data as there is no transfer command that would generate or require amounts of data outside this range. Excessive data sent to the DSO beyond that required by the command in operation will be accepted and discarded.

During binary (raw) transfers the data transmitted must conform to the IEEE standards for <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>.

5.3 RS423/GPIB Commands

This section contains information about the remote commands used and recognized by the DSO. Following the summary in section 5.3.1 the commands ineach subsystem are described.

5.3.1 RS423/GPIB Command Summary

This alphabetical list of the interface commands can be used to find the command's subsystem. To find detailed explanations of a command, see the appropriate subsystem section of 5.3.2. Figure 5.3.1 shows all the commands in a tree diagram.

Command	Subsystem
*CAL?	Common
*CLS	Common
*ESE	Common
*ESE?	Common
*ESR?	Common
*IDN?	Common
*OPC	Common
*OPC?	Common
*OPT?	Common
*RST	Common
*SRE	Common
*SRE?	Common
*STB?	Common
*TRG	Common
*TST?	Common
*WAI	Common
:ABORT	Root
:ACQuisition	:TRANsfer
:ADD	:CHANnel{1 | 2 | 3 | 4}
:AGAteb	:TRIGger
:ALL	:TRANsfer:ACQuisition
:ALL	:TRANsfer:DISPlay
:ALL	:TRANsfer:MEMory
:ALL	:TRANsfer:REFerenceTRace
:ALL?	Root
:ALPHABrightness	:DISPlay
:AUTosetup	Root
:AUTotrig	:TRIGger
:AVeraGe	:ACQuisition
:BandwidthLimit	Root
:BAUD	:PLOT
:BEEP	Root
:BOTHPULSEwidth	:CURSor
:BPC	:PLOT
:BRIGhtupcontrast	:DISPlay
:CALCulation{1 | 2 | 3}	:CURSor
:CAPtureandREPeat	:POSTStore
:CLeaR	:MEMory
:COUPling	:CHANnel{1 | 2 | 3 | 4}
:COUpling	:TRIGger{A | B}
:DATAonly	:TRANsfer:ACQuisition
:DATAonly	:TRANsfer:DISPlay
:DATAonly	:TRANsfer:MEMory
:DATAonly	:TRANsfer:REFerenceTRace
:DATE	Root
:DELay	:TRIGGER{A | B}
:DEst	:PLOT
:DESTination	:ARITHmetic
:DISPlay	:LIMits
:DISPlay	:TRANsfer
:ECHOandprompt	Root
:ENable	:ACQuisition:AVeraGe
:ENable	:CALibrate
:ERRor	:SYStem
:ERRorCLear	:SYStem
:EXEcute	:ARITHmetic
:FACTor	:ACQuisition:AVeraGe
:FILter	:POSTStore
:FILterFACtor	:POSTStore
:FORce	:CALibrate
:FORMAT	:DATE
:FORMat	:TRANsfer
:FUnction	:ARITHmetic
:GRATBrightness	:DISPlay
:GRaticule	:PLOT
:HAnd	:PLOT
:HEADer	:SYStem
:HELP?	Root
:HELPEXT	Root
:HIGHRISEtime	:CURSor
:HOld	:CHANnel{1 | 2 | 3 | 4}
:HOLDALL	:DISPlay
:INITialise	:POSTStore
:INITialize	:POSTStore
:INTegrate	:POSTStore
:INTegrateScaling	:POSTStore
:INVert	:POSTStore
:KEYclick	Root
:LABELsdatecursor	:PLOT
:LEFTPULSEwidth	:CURSor
:LER?	Root
:LEVel	:TRIGger{A | B}
:LIMIT	:TRANsfer
:LONGform	:SYStem
:LOWer	:LIMits
:LOWer	:TRANsfer:LIMIT
:LOWRISEtime	:CURSor

Command	Subsystem
:LTER?	Root
:MAXmin	:ACQuisition
:MEASure	:CURSor
:MEMory	:TRANsfer
:MENU	Root
:MODE	:CURSor
:MODE	:LIMits
:MOde	:ACQuisition
:MOde	:PLOT
:MULTscaling	:ARITHmetic
:PARity	:PLOT
:PEnchange	:PLOT
:PERSCycles	:DISPlay
:PERSDotjoin	:DISPlay
:PERSMode	:DISPlay
:PERSTime	:DISPlay
:PERStype	:PLOT
:PLOT	Root
:PlotonFAIL	:LIMits
:POSition	:CHANnel{1 | 2 | 3 | 4}
:PREPost	:TRIGger{A | B}
:PREtrig	:TRIGger{A | B}
:PRObe	:CHANnel{1 | 2 | 3 | 4}
:RADIX	:TRANsfer
:RANGe	:CHANnel{1 | 2 | 3 | 4}
:RECall	:MEMory
:RECALL	:SETup
:REFerenceTRace	:TRANsfer
:REFerenceTRace	:DISPlay
:REPeat	:POSTStore
:RESTore	:AUTosetup
:REStore	:POSTStore
:RESult{1 | 2 | 3}?	:CURSor
:RIGHTPULSEwidth	:CURSor
:RUN	:ACQuisition
:SAVE	:MEMory
:SAVE	:SETup
:SAVE	:REFerenceTRace
:SAVEALL	:REFerenceTRace

Command	Subsystem
:SEParation	:ACQuisition
:SER?	Root
:SETup	:TRANsfer
:SLOpe	:TRIGger{A | B}
:Source1	:ARITHmetic
:Source2	:ARITHmetic
:SOurce	:TRIGger{A | B}
:STAte	:CHANnel{1 | 2 | 3 | 4}
:STatus	:ACQuisition
:STopBits	:PLOT
:SWeep	:ACQuisition
:TERM50	:CHANnel{1 | 2 | 3 | 4}
:TEXT	Root
:TIME	Root
:TimeBASE{A | B}	:ACQuisition
:TRAce	:CURSor
:TRace	:DISPlay
:TRACEBrightness	:DISPlay
:TRACEDotjoin	:DISPlay
:TRANSparency	:MENU
:TVSyncpolarity	:TRIGger{A | B}
:TVtrigger	:TRIGger{A | B}
:UNcal	:CHANnel{1 | 2 | 3 | 4}
:UPper	:LIMits
:UPper	:TRANsfer:LIMIT
:VARiable	:CHANnel{1 | 2 | 3 | 4}
:WindowSTArt	:TRANsfer
:WindowSTOp	:TRANsfer
:XMAG	:DISPlay
:XMAg	:POSTStore
:Xpos	:CURSor
:Xpos	:DATum
:XSHift	:DISPlay
:XSHift	:POSTStore
:XY	:DISPlay
:XYPERSBrightness	:DISPlay
:YMAg	:POSTStore
:Ypos	:DATum
:YSHift	:POSTStore

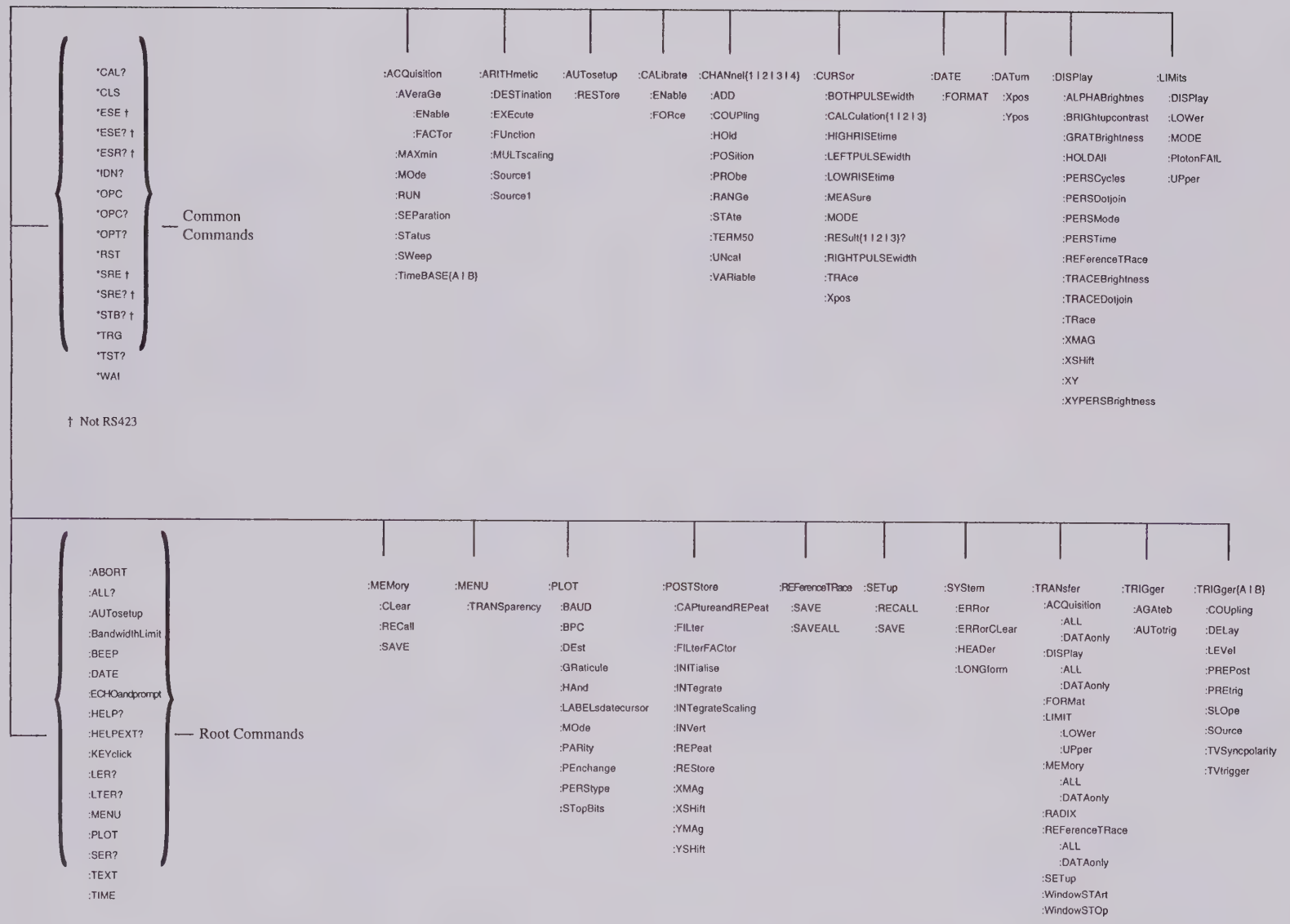


Figure 5.3.1 GPIB/RS423 Command Tree

ACQuisition Subsystem

The Acquisition Subsystem is used for controlling all aspects of the instrument's acquisition performance.

COMMANDS

:ACQuisition
- :Average
  - :Enable
  - :FACTor
- :MAXmin
- :MOde
- :RUN
- :SEParation
- :STatus
- :SWeep
- :TimeBASE{A | B}

Name: **AVeraGe:ENable**

Type: Command, Query

Function: This command turns the averaging function on or off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the averaging function.

Command Syntax: :ACQuisition:AVeraGe:ENable {numeric | OFF | ON}

Example: :ACQuisition:AVeraGe:ENable ON

Query syntax: :ACQuisition:AVeraGe:ENable?

Returned Format: :ACQuisition:AVeraGe:ENable {0 | 1}

Name: **AVeraGe:FACTor**

Type: Command, Query

Function: This command sets the averaging factor. The possible factors are 2, 4, 8, 16, 32, 64, 128 and 256 although any number may be sent as it will be rounded to the nearest allowable factor.

This query returns the current averaging factor.

Command Syntax: :ACQuisition:AVeraGe:FACTor {numeric | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256}

Example: :ACQuisition:AVeraGe: FACTor 64

Query syntax: :ACQuisition:AVeraGe: FACTor?

Returned Format: :ACQuisition:AVeraGe: FACTor {2 | 4 | 8 | 16 | 32 | 64 | 128 | 256}

Name: **MAXmin**

Type: Command, Query

Function: This command turns the Max/Min function on and off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the Max/Min function.

Command Syntax: :ACQuisition:MAXmin {ON | OFF}

Example: :ACQuisition:MAXmin ON

Query syntax: :ACQuisition:MAXmin?

Returned Format: :ACQuisition:MAXmin {1 | 0}

Name: **MOde**

Type: Command, Query

Function: This command is used to set the acquisition Mode and has the same function as the front panel button (18). The modes can be Refresh, Roll or Persistence.

This query returns the current acquisition mode.

Command Syntax: :ACQuisition:MOde {REfresh | ROll | PERsist}

Example: :ACQuisition:MOde ROll

Query syntax: :ACQuisition:MOde?

Returned Format: :ACQuisition:MOde {REfresh | ROll | PERsist}

Name: **RUN**

Type: Command, Query

Function: This command has the same effect as pressing the front panel run button (17) or the single shot button (15).

This query returns the current run status

Command Syntax: :ACQuisition:RUN {Single | Continuous}

Example: :ACQuisition:RUN Continuous

Query syntax: :ACQuisition:RUN?

Returned Format: :ACQuisition:RUN {Single | Continuous}

Name: **SEParation**

Type: Command, Query

Function: This command is used to separate the A and B trace sweeps vertically. The numeric values are in screen divisions and may be either positive or negative. Zero means no separation.

This query returns the current vertical separation of the two horizontal sweeps; A and B.

Command Syntax: :ACQuisition:SEParation {Value}

Example: :ACQuisition:SEParation 4.2

Query syntax: :ACQuisition:SEParation?

Returned Format: :ACQuisition:SEParation {value}

Name: **STatus?**

Type: Query

Function: This query returns the current acquisition status of the instrument.

A Stands for 'Armed'

F Indicates that the acquisition store has been 'filled' with enough pre-trigger information to be ready for a fresh acquisition.

T Stands for 'Triggered': the instrument has received or generated a valid trigger; acquisition has begun.

S 'Stored': acquisition is complete.

Query syntax: :ACQuisition:STatus?

Returned Format: :ACQuisition:STatus {A | AF | AFT | AFTS}

ACQuisition Subsystem

Name: **SWeep**

Type: Command, Query

Function: This command is used to set the timebase sweep options. These are A only, B only and A and B alternately (AALTB)

This query returns the current state of the sweep options.

Command Syntax: :ACQuisition:SWeep {A | B | AALTB}

Example: :ACQuisition:SWeep AALTB

Query syntax: :ACQuisition:SWeep?

Returned Format: :ACQuisition:SWeep {A | B | AALTB}

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Name: **TimeBASE**

Type: Command, Query

Function: This command is used to set the timebase speed. The valid values are:20E-9, 50E-9, 100E-9, 125E-9, 250E-9, 500E-9, 1E-6, 2E-6, 5E-6, 10E-6, 20E-6, 50E-6, 100E-6, 200E-6, 500E-6, 1E-3, 2E-3, 5E-3, 10E-3, 20E-3, 50E-3, 100E-3, 200E-3, 500E-3, 1, 2, 5, 10, 20, 50 Any other number may be sent and it will be rounded.

Although the above values are the most obvious choices, numbers such as 5E-1 or 0.0005E3 are just as valid.

This query returns the current timebase speed.

Command Syntax :ACQuisition:TimeBASE{A | B | *} value

Example: :ACQuisition:TimeBASEA 200E-6

Query syntax: :ACQuisition:TimeBASEB?

Returned Format: :ACQuisition:TimeBASE {A|B|*} number

The ARITHmetic Subsystem is used for controlling trace arithmetic.

COMMANDS

:ARITHmetic
- :DESTination
- :EXEcute
- :FUnction
- :MULTscaling
- :Source1
- :Source2

Name: **DESTination**

Type: Command, Query

Function: This command defines the trace where results of arithmetic calculations are to be displayed. The allowable options are:

TRace1A, TRace1B, TRace2A, TRace2B, TRace3A, TRace3B, TRace4A, TRace4B.

This query returns the trace name where arithmetic calculation results are to be displayed.

Command Syntax: :ARITHmetic:DESTination {trace}

Example: :ARITHmetic:DESTination TR2A

Query syntax: :ARITHmetic:DESTination?

Returned Format: :ARITHmetic:DESTination {trace}

Name: **EXEcute**

Type: Command

Function: This command forces the currently set arithmetic operation to occur. Before issuing this command The destination, function and operands should have been set.

Command Syntax: :ARITHmetic:EXEcute

Example: :ARITHmetic:EXEcute

Note: *See also DESTination, FUnction and OPerand.*

Name: **FUnction**

Type: Command, Query

Function: This command sets the arithmetic function to be performed. Traces may be Added, Subtracted or Multiplied.

This query returns the arithmetic function selected.

Command Syntax: :ARITHmetic:FUnction {ADD | SUBtract | MULtiply}

Example: :ARITHmetic:FUnction ADD

Query syntax: :ARITHmetic:FUnction?

Returned Format: :ARITHmetic:FUnction {ADD | SUBtract | MULtiply}

ARITHmetic Subsystem

Name: **MULTScaling**

Type: Command, Query

Function: This command set the scaling factor to be applied to the result of a trace multiplication.

This query returns the scaling factor to be applied to the result of a trace multiplication.

Command Syntax: :ARITHmetic:MULTScaling {x1.0 | x0.5 | x0.2 | x0.1}

Example: :ARITHmetic:MULTScaling x0.5

Query syntax: :ARITHmetic:MULTScaling?

Returned Format: :ARITHmetic:MULTScaling {x1.0 | x0.5 | x0.2 | x0.1}

Note: *Although values such as 0.5 are the most obvious choices, numbers such as 5e-1 or 0.0005e3 are just as valid.*

Name: **SOurce**

Type: Command, Query

Function: This command is used to define the traces used as the operands for an arithmetic manipulation. The command needs to be used twice once as SOurce 1 and once as SOurce 2.

The allowable options are:

TRace1A, TRace1B, TRace2A

TRace2B, TRace3A, TRace3B

TRace4A and TRace4B.

This query will return the trace name of either source 1 or 2.

Command Syntax: :ARITHmetic:SOurce {1 | 2} {trace}

Example: :ARITHmetic:SOurce TRace1B

Query syntax: :ARITHmetic:SOurce{1 | 2}?

Returned Format: :ARITHmetic:SOurce{trace}

AUTosetup Subsystem

The AUTosetup Subsystem is used for controlling the AUTO SETUP restore routine.

COMMANDS
:AUTosetup
    :RESTore

Name: **RESTore**

Type: Command

Function: This command, is only available immediately after an AUTosetup command. It will restore the instrument to the status it had before the autosetup. Note that AUTosetup is a root command.

Command Syntax: :AUTosetup:RESTore

Example: :AUTosetup:RESTore

CALibrate Subsystem

The CALibrate Subsystem is used for controlling the instrument's internal calibration routines.

COMMANDS
:CALibrate
    :Enable
    :FORce

Name: **ENable**

Type: Command, Query

Function: This command is used to enable or disable all the instrument's automatic calibration routines. Numeric values may be sent, 0 is interpreted as OFF i.e calibrations disabled and any other number is interpreted as ON; calibrations enabled.

This query returns the state of the instrument's calibration routines, either enabled or disabled.

Command Syntax: :CALibrate:ENable{ON | OFF}

Example: :CALibrate:ENableON

Query syntax: :CALibrate:ENable?

Returned Format: :CALibrate:ENable {0 | 1}

Name: **FORce**

Type: Command

Function: This command forces a calibration to be carried out. The calibration will be the next one that would have due, i.e. if this command is sent during the first 15 minutes after power up a warm start calibration will be performed. At other times a temperature calibration will happen.

Command Syntax: :CALibrate:FORce

Example: :CALibrate:FORce

CHANnel Subsystem

The CHANnel Subsystem is used for controlling all aspects of the input channel performance.

COMMANDS

:CHANnel{1 | 2 | 3 | 4}
- :ADD
- :COUPling
- :HOld
- :POSition
- :PRObe
- :RANGe
- :STate
- :TERM50
- :UNcal
- :VARiable

Name: **ADD**

Type: Command, Query

Function: This command is used to Add traces from channel pairs together. Channel 1 can be added to channel 2, and channel 3 can be added to channel 4. If either half of the channel pair is sent, the other channel of the pair is to be included. If channels to be added are not currently on when this command is sent, they will be turned on.

Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current Add status of the requested channel.

Command Syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:ADD {numeric | ON | OFF}

Example: :CHANnel2:ADD ON

Query syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:ADD?

Returned Format: :CHANnel{1 | 2 | 3 | 4}: ADD {1 | 0}

See also: Display and Coupling

Name: **COUPling**

Type: Command, Query

Function: This command is used to set a channels input coupling to either AC, DC or Ground.

This query returns the current channel coupling.

Command Syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:COUPling {AC | DC | GND}

Example: :CHANnel2: COUPling DC

Query syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:COUPling?

Returned Format: :CHANnel{1 | 2 | 3 | 4}:
COUPling {AC | DC | GND}

Name: **HOld**

Type: Command, Query

Function: This command is used to hold a channel display.

Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current hold status of a channel.

Command Syntax: :CHANnel{1 | 2 | 3 | 4 | *}:HOld {numeric | OFF | ON}

Example: :CHANnel3:HOld ON

Query syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:HOld?

Returned Format: :CHANnel{1 | 2 | 3 | 4}:HOld {0 | 1}

See also: DISPlay:HOLDAll

Name: **POSition**

Type: Command, Query

Function: This command is used to position a channel's displayed trace vertically on the screen. The numeric data is sent in screen divisions with -4 being the bottom of the screen, 0 the center and 4 the top. The maximum range is ±12 divisions.

This query returns the vertical position of a channel's trace display.

Command Syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:POSition {value}

Example: :CHANnel1:POSition 4.5

Query syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:POSition?

Returned Format: :CHANnel{1 | 2 | 3 | 4}
:POSition {value}

Name: **PROBe**

Type: Command, Query

Function: This command is used to set the probe ratio for a channel. Ratios that may be matched are x1, x10, x100 and x1000.

This query returns the current probe ratio for a channel.

Command Syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:PROBe {1 | 10 | 100 | 1000}

Example: :CHANnel4:PROBe 1000

Query syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:PROBe?

Returned Format: :CHANnel{1 | 2 | 3 | 4}:PROBe
{1 | 10 | 100 | 1000}

Name: **RANGe**

Type: Command, Query

Function: This command is used to set the vertical scaling of a channel. The set of values are: 2E-3, 5E-3, 10E-3, 20E-3, 50E-3, 100E-3, 200E-3, 500E-3, 1, 2 and 5.

Although the above values are the most obvious choices, numbers such as 5E-1 or 0.0005E3 are just as valid.

Any other number may be sent and it will be rounded.

This query returns the current vertical scaling for a channel.

Command Syntax: **:CHANnel{1 | 2 | 3 | 4 | *}**
:RANGe {value}

Example: :CHANnel1:RANGe 50E-3

Query syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:RANGe?

Returned Format: :CHANnel{1 | 2 | 3 | 4}:RANGe
{value}

Name: **STAte**

Type: Command, Query

Function: This command is used to set the status of a channel which may be set to be Off, On or Inverted.

This query returns the current state of a channel.

Command Syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:STAte { OFF | ON | INVert}

Example: :CHANnel2: STAte ON

Query syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:STAte?

Returned Format: :CHANnel{1 | 2 | 3 | 4}: STAte
{OFF | ON | INVert}

Name: **TERM50**

Type: Command, Query

Function: This command is used to turn on or off the 50Ω termination to a channel input.

Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the 50Ω termination to a channel.

Command Syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:TERM50 {numeric | OFF | ON}

Example: :CHANnel2: TERM50 ON

Query syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:TERM50?

Returned Format: :CHANnel{1 | 2 | 3 | 4}
:TERM50 {0 | 1}

Name: **UNcal**

Type: Command, Query

Function: This command is used to turn the Uncal feature of a channel On and Off.

Numeric values may be sent, 0 is interpretted as OFF and any other number is interpreted as ON.

When UNcal is On, the gain of a channel is determined by the VARiable command.

This query returns the channel's uncal status.

Command Syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:UNcal {numeric | OFF | ON}

Example: :CHANnel3: UNcal ON

Query syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:UNcal?

Returned Format: :CHANnel{1 | 2 | 3 | 4}: UNcal {0 | 1}

Name: **VARiable**

Type: Command, Query

Function: This command is used in conjunction with the UNcal command to apply a variable gain to a channel input. Once UNcal has been set to On, the channel gain is determined by the value sent by this command. The gain can be set from 20% to 100%.

This query returns the current variable gain of a channel.

Command Syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:VARiable {value}

Example: :CHANnel4:VARiable 25

Query syntax: :CHANnel{1 | 2 | 3 | 4 | *}
:VARiable?

Returned Format: :CHANnel{1 | 2 | 3 | 4}:VARiable {value}

The Common commands are commands defined by the IEEE 488.2 standard. This section details the DSO's implementation of the relevant commands.

COMMANDS

*CAL	query only
*CLS	
*ESE	
*ESR	query only
*IDN	query only
*OPC	
*OPT	query only
*RST	
*SRE	
*STB	query only
*TRG	
*TST	query only
*WAI	

Name: ***CAL?**

Type: Query

Function: This query forces the DSO to perform a self-test. The DSO actions the auto-calibration routine and returns a "0" if everything is correct, a "1" if the calibration is marginal or a "2" if the instrument has failed to calibrate.

Query syntax: :*CAL?

Returned Format: :*CAL {0 | 1 | 2}

Name: ***CLS**

Type: Command

Function: Clear Status. This command is used to clear the DSO's status registers. See figure 5.2.

Command Syntax: :*CLS

Example: :*CLS

Name: ***ESE**

Type: Command, Query **Not RS423**

Function: Event Status Enable. This command is used to set the Standard Event Status Enable Register bits. See figure 5.2. The bits set by this command enable the matching bits in the Standard Event Status Register.

This query returns the contents of the Standard Event Status Enable Register. See figure 5.2.

The numeric value for both the command and query is in the range 0-255.

Command Syntax: :*ESE {numeric}

Example: :*ESE 189

Query syntax: :*ESE?

Returned Format: :*ESE {numeric}

Name: ***ESR?**

Type: Query **Not RS423**

Function: Event Status Register. This query returns the contents of the Standard Event Status Register. See figure 5.2.

The numeric value returned is in the range 0-255.

Performing this query clears the corresponding register.

Query syntax: :*ESR?

Returned Format: :*ESR {numeric}

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Name: ***IDN?**

Type: Query

Function: This query returns the instrument type and software version.

Query syntax: :*IDN?

Returned Format: :*IDN GOULD,{610 | 620}, 0,V1.230456

Notes *The 0 in the return is the serial number field and is not available over the GPIB. The first three digits after the V form the software version fitted to the instrument and the last 4 digits are the IVN (Internal Version Number) number of the software which changes each time the software is updated.*

Name: ***OPC**

Type: Command, Query

Function: Operation Complete This command causes the DSO to set the operation complete bit in the Standard Event Status Register when all pending device operations are complete.

This query returns a "1" when when all pending selected device operations are complete.

Command Syntax: :*OPC

Example: :*OPC

Query syntax: :*OPC?

Returned Format: :1

Name: ***OPT?**

Type: Query

Function: This query is used to find out which options are fitted to the DSO.

Query syntax: :*OPT?

Returned Format: :*OPT? {GPIB | RS423},{0 | COLOR PLOTTER | THERMAL PLOTTER}, {0 | TV Trigger}

Name: *RST

Type: Command

Function: This command resets the instrument to its default state. The GPIB or RS423 interface setup will not change nor will the instrument's calibration settings. The table below shows the DSO's default state.

Acquisition	
Acquisition mode	Continuous Refresh
Maxmin	Off
Bandwidthlimit	Off
Display Modes	
Menus	Off
XY	Off
Timebase	A
Traces	TR1A,TR2A, TR3A, TR4A
Hold	Off
Dot join	On
X shift	Centered
Persistence dot join	Off
Persistence	Off
Persistence type	Time
Persistence time	5 secs
Persistence cycles	50
Averaging	Off
Averaging factor	2
Limits test	Off
Intensity Trace	10
Bright up	8
Alpha/cursor	10
Graticule	3
XY/pers	10
Horizontal	
Range	50µs/div
Uncal	Off
Sweeps	A Sweep
X-Mag	Off
Vertical	
Coupling	Gnd
Uncal	Off
Y shift	Centered
Probe Gain	x1
Termination	1MΩ
Add	Off
Invert	Off
Range	5V/div
Channel selection	All On
Trigger	
Control	A Trigger
Slope	Positive
Source	Channel 1
Coupling	AC
Level	Centered
Pre/post	Pretrigger
Pretrigger	0%
Delay	0s
TVtrigger	Off
TVsync	Negative
A Gate B	Off
Autotrigger	On
Cursor	
Cursor	Off
Cursor trace	None
Cursor X position	Centered
Time Datum X position	Centered
Voltage Datum Y position	Centered
Mode	Absolute
Pulsewidth points %	50
Risetime %	10/90
Calculations	Volt/time, none,none
Trace arithmetic	
Mode	Off
Operand 1	TRC1A
Operator	Add
operand 2	TRC1A
Scale	x1
Plot	
Plotter type	Internal Color plotter (if fitted)
Labels, date, cursor	On
Graticule	Solid
Mode	Single
Persistence type	Solid
Limits type	Line
I/O	
Baud	9600
BPC	8
Parity	None
Stop Bits	1
Handshake	XONXOFF
GPIB Address	7
Misc	
Keyclick	On
Menu transparency	Off
Date format	MM-DD-YY

Command Syntax: :*RST

Example: :*RST

Name: *SRE

Type: Command, Query **Not RS423**

Function: Service Request Enable Register. This command is used to set the Service Request Enable Register bits. See figure 5.2. The bits set by this command enable the matching bits in the Status Byte Register.

This query returns the contents of the Service Request Enable Register. See figure 5.2.

The numeric value for both the command and query is in the range 0-255.

Command Syntax: :*SRE {numeric}

Example: :*SRE 183

Query syntax: :*SRE?

Returned Format: :*SRE {numeric}

Name: *STB?

Type: Query **Not RS423**

Function: This query returns the contents of the Status Byte Register. See figure 5.2.

The numeric value returned is in the range 0-255.

The MSS (Master Summary Status) bit reported on bit 6 of this register indicates whether or not the DSO had at least one reason for requesting service.

To read the instrument's status byte with RQS on bit 6, use the serial poll facility.

Query syntax: :*STB?

Returned Format: :*STB {numeric}

Name: *TRG

Type: Command

Function: This command has the same function as the ACQ:RUN SINGLE command, or the front panel single shot key.

Command Syntax: :*TRG

Example: :*TRG

Name: *TST?

Type: Query

Function: This query forces the DSO to perform a self-test. The DSO actions the auto-calibration routine and returns a "0" if everything is correct, a "1" if the calibration is marginal or a "2" if the instrument has failed to calibrate.

Query syntax: :*TST?

Returned Format: :*TST {numeric}

Name: *WAI

Type: Command

Function: This command does not set a bit or return a value, it instructs the DSO to wait until all pending operations are complete when it will respond to further commands. While it is waiting, the instrument will not action any further commands.

This command should be used whenever it is required to be sure that a previous command or event has happened before actioning another command. e.g. between performing a single shot acquisition on a timebase of 50s/div and transferring the acquisition data, a *WAI command should be issued to ensure that the acquisition is complete.

Command Syntax: :*WAI

Example: :*WAI

The Cursor Subsystem is used for controlling all aspects of the cursor movement and waveform measurements.

COMMANDS

:CURSor
- :BOTHPULSEwidth
- :CALCulation{1 | 2 | 3}
- :HIGHRISEtime
- :LEFTPULSEwidth
- :LOWRISEtime
- :MEASure
- :MODE
- :RESult{1 | 2 | 3}?
- :RIGHTPULSEwidth
- :TRAce
- :Xpos

Name: BOTHPULSEwidth

Type: Command, Query

Function: This command is used to set both percentage points used for the pulsewidth calculation and can be any whole number from 1 to 99.

This query returns the pulsewidth percentage points.

Command Syntax: :CURSor:BOTHPULSEwidth {numeric}

Example: :CURSor:BOTHPULSEwidth 50

Query syntax: :CURSor:BOTHPULSEwidth?

Returned Format: :CURSor:BOTHPULSEwidth {numeric}

Name: **CALCulation**

Type: Command, Query

Function: This command is used to select the calculations for the three cursor measurements. These measurements will be performed by the MEASure command

This command should be followed by a *WAI command before using the MEASure command.

Command Syntax: :CURSor:CALCulation{1 | 2 | 3 | *} {OFF| VOLTTime | VOLTInvTime | PEAKtopeak | MAXmin | RISEtime | OVERshoot | PULSEwidth | FREQuency | RMS | AREA | TOP | AMPlitude}

Example: :CURSor:CALCulation1 VOLTTime

Query syntax: :CURSor:CALCulation{1 | 2 | 3 | *}?

Returned Format: :CURSor:CALCulation{1 | 2 | 3} {OFF| VOLTTime | VOLTInvTime | PEAKtopeak | MAXmin | RISEtime | OVERshoot | PULSEwidth | FREQuency | RMS | AREA | TOP | AMPlitude}

See also: MEASure, RESult

Name: **HIGHRISEtime**

Type: Command, Query

Function: This command is used to set the high percentage point used for the risetime calculation and can be any whole number from 1 to 99.

This query returns the risetime high percentage point.

Command Syntax: :CURSor:HIGHRISEtime {numeric}

Example: :CURSor:HIGHRISEtime 82

Query syntax: :CURSor:HIGHRISEtime?

Returned Format: :CURSor:HIGHRISEtime {numeric}

Name: **LEFTPULSEwidth**

Type: Command, Query

Function: This command is used to set the left hand pulse edge percentage point used for the pulsewidth calculation and can be any whole number from 1 to 99.

This query returns the pulsewidth left hand percentage point.

Command Syntax: :CURSor:LEFTPULSEwidth {numeric}

Example: :CURSor:LEFTPULSEwidth 45

Query syntax: :CURSor:LEFTPULSEwidth?

Returned Format: :CURSor:LEFTPULSEwidth {numeric}

Name: **LOWRISEtime**

Type: Command, Query

Function: This command is used to set the low percentage point used for the risetime calculation and can be any whole number from 1 to 99.

This query returns the risetime low percentage point.

Command Syntax: :CURSor:LOWRISEtime {numeric}

Example: :CURSor:LOWRISEtime 27

Query syntax: :CURSor:LOWRISEtime?

Returned Format: :CURSor:LOWRISEtime {numeric}

Name: **MEASure**

Type: Command

Function: This command is used to perform the cursor measurements set by the CALCulation command.

This command should be followed by a *WAI command before using the RESult command.

Command Syntax: :CURSor:MEASure

Example: :CURSor:MEASure

See also: CALCulation, RESult

Name: **MODE**

Type: **Command, Query**

Function: This command determines which mode the cursor measurements will be made in either Absolute mode with respect to ground and the lefthand edge of the screen or Delta Mode with respect to the datum lines.

This query returns the current cursor mode

Command Syntax: :CURSor:MODE{ABS | DELTA}

Example: :CURSor:MODE ABS

Query syntax: :CURSor:MODE?

Returned Format: :CURSor:MODE{ABS | DELTA}

Name: **RESult?**

Type: Query

Function: This query is used to obtain the results of the calculations set by the calculation command and performed by the measure command. The text returned is identical to the corresponding calculation line on the DSO's display.

To obtain the results to all the calculations, the * version of this query should be used.

Query syntax: :CURSor:RESult{1 | 2 | 3 | *}?

Returned Format: :CURSor:RESult{1 | 2 | 3 | *} text

See also: CALCulation, MEASure

Name: **RIGHTPULSEwidth**

Type: **Command, Query**

Function: This command is used to set the right hand pulse edge percentage point used for the pulsewidth calculation and can be any whole number from 1 to 99.

This query returns the pulsewidth right hand percentage point.

Command Syntax: :CURSor:RIGHTPULSEwidth {numeric}

Example: :CURSor:RIGHTPULSEwidth 54

Query syntax: :CURSor:RIGHTPULSEwidth?

Returned Format: :CURSor:RIGHTPULSEwidth {numeric}

Name: **Xpos**

Type: Command, Query

Function: This command sets the cursor position along the trace. The numeric value is in screen divisions from the left hand side of the screen. 0 is the left hand edge and 10 is the right hand edge.

This query returns the current horizontal position of the cursor.

Command Syntax: :CURSor:Xpos{numeric)

Example: :CURSor:Xpos 5.7

Query syntax: :CURSor:Xpos?

Returned Format: :CURSor:Xpos{numeric}

Name: **TRAce**

Type: Command, Query

Function: This command is used to select the trace that the cursor and datum lines are applied to. The possible traces are 1A, 1B, 2A, 2B, 3A, 3B, 4A and 4B. OFF can also be sent to turn the cursor off.

This query returns the trace that the cursor is applied to.

Command Syntax: :CURSor:TRAce {TRace1A | TRace1B | TRace2A | TRace2B | TRace3A | TRace3B | TRace4A | TRace4B | OFF}

Example: :CURSor:TRAce TRace2B

Query syntax: :CURSor:TRAce?

Returned Format: :CURSor:TRAce{TRace1A | TRace1B | TRace2A | TRace2B | TRace3A | TRace3B | TRace4A | TRace4B | OFF}

DATE Subsystem

The DATE Subsystem is used to set the format of the date.

COMMANDS
:DATE
:FORMAT

Name: **FORMAT**

Type: Command, Query

Function: This command sets the date format to be either month-day- year (MM-DD-YY) or day-month-year (DD-MM-YY). This format is then used on all screen displays and plot outputs. The chosen format is also used for all data transfers from the instrument.

This query returns the current date format.

Command syntax: :DATE:FORMAT {MM-DD-YY | DD-MM-YY}

Example: :DATE:FORMAT MM-DD-YY

Query syntax: :DATE:FORMAT?

Returned Format: :DATE:FORMAT {MM-DD-YY | DD-MM-YY}

Note: *The DSO can always accept dates in either MM-DD-YY or DD-MM-YY format but will output dates in the format set by this command.*

DATum Subsystem

The DATum Subsystem is used for controlling the time and voltage datum positions.

COMMANDS
:DATum
:Xpos
:Ypos

Name: **Xpos**

Type: Command, Query

Function: This command is used to position the vertical datum with respect to the left hand edge of the display. The numeric data is in screen divisions with 0 being the left hand edge and 10 the right hand edge of the display.

This query returns the X position of the vertical datum line.

Command Syntax: :DATum:Xpos{numeric}

Example: :DATum:Xpos4.7

Query syntax: :DATum:Xpos?

Returned Format: :DATum:Xpos{numeric}

Name: **Ypos**

Type: Command, Query

Function: This command is used to position the horizontal datum with respect to the center of the display. The numeric data is in screen divisions with 0 being the center and 4 the top of the display. The permissible range is ±4.8 divisions.

If the instrument is in ABS mode, the horizontal datum cannot be moved as it is fixed to the selected trace ground.

This query returns the Y position of the horizontal datum line.

Command Syntax: :DATum:Ypos{numeric}

Example: :DATum:Ypos1.4

Query syntax: :DATum:Ypos?

Returned Format: :DATum:Ypos{numeric}

DISPlay Subsystem

The DISPlay Subsystem is used for controlling all aspects of the instrument's display characteristics.

COMMANDS

:DISPlay
- :ALPHABrightness
- :BRIGhtupcontrast
- :GRATBrightness
- :HOLDAll
- :PERSCycles
- :PERSDotjoin
- :PERSMode
- :PERSTime
- :REFerenceTRace
- :TRACEBrightness
- :TRACEDotjoin
- :TRace
- :XMAG
- :XSHift
- :XY
- :XYPERSBrightness

Name: **ALPHABrightness**

Type: Command, Query

Function: This command is used to set the brightness of the alphanumerics on the screen display. The brightness level can be set from 0 to 15.

This query returns the current brightness of the screen alphanumerics.

Command Syntax: :DISPlay:ALPHABrightness {numeric}

Example: :DISPlay:ALPHABrightness 5

Query syntax: :DISPlay:ALPHABrightness?

Returned Format: :DISPlay:ALPHABrightness {numeric}

Name: **BRIGhtupcontrast**

Type: Command, Query

Function: This command is used to set the level of the bright-up contrast on the screen display. The brightness level can be set from 0 to 8.

This query returns the current bright-up contrast level of the screen display.

Command Syntax: :DISPlay:BRIGhtupcontrast {numeric}

Example: :DISPlay:BRIGhtupcontrast 6

Query syntax: :DISPlay:BRIGhtupcontrast?

Returned Format: :DISPlay:BRIGhtupcontrast {numeric}

Name: **GRATBrightness**

Type: Command, Query

Function: This command is used to set the brightness of the graticule on the screen display. The brightness level can be set from 0 to 15. A brightness level of 0 means off.

This query returns the current brightness of the screen graticule.

Command Syntax: :DISPlay:GRATBrightness {numeric}

Example: :DISPlay:GRATBrightness 15

Query syntax: :DISPlay:GRATBrightness?

Returned Format: :DISPlay:GRATBrightness {numeric}

Name: **HOLDALL**

Type: Command, Query

Function: This command is used to turn the hold all function On and Off to freeze all channel displays in the same way as the front panel control Hold all control (19). Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the Hold All function.

Command Syntax: :DISPlay:HOLDALL {numeric | OFF | ON}

Example: :DISPlay:HOLDALL ON

Query syntax: :DISPlay:HOLDALL?

Returned Format: :DISPlay:HOLDALL{0 | 1}

Name: **PERSCycles**

Type: Command, Query

Function: This command is used to set the number of acquisitions that will be used to make up a persisted display. The valid numbers are 10, 20, 50, 100, 200, 500 and Continuous. Other numbers will be rounded.

This query returns the number of acquisitions selected to form a persisted display.

Command Syntax: :DISPlay:PERSCycles {10 | 20 | 50 | 100 | 200 | 500 | CONTinuous}

Example: :DISPlay:PERSCycles 20

Query syntax: :DISPlay:PERSCycles?

Returned Format: :DISPlay:PERSCycles {10 | 20 | 50 | 100 | 200 | 500 | CONTinuous}

Name: **PERSDotjoin**

Type: Command, Query

Function: This command is used to turn the persistence dot join function On and Off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the persistence dot join function.

Command Syntax: :DISPlay:PERSDotjoin {numeric | OFF | ON}

Example: :DISPlay:PERSDotjoin OFF

Query syntax: :DISPlay:PERSDotjoin?

Returned Format: :DISPlay:PERSDotjoin {0 | 1}

Name: **PERSMode**

Type: Command, Query

Function: This command is used to set the persistence mode to either time or cycles, i.e to build up a composite display for either a set time or a set number of acquisitions.

This query returns the current state of the persistence mode.

Command Syntax: :DISPlay:PERSMode {TIME | CYCLES}

Example: :DISPlay:PERSMode TIME

Query syntax: :DISPlay:PERSMode?

Returned Format: :DISPlay:PERSMode {TIME | CYCLES}

Name: **PERSTime**

Type: Command, Query

Function: This command is used to set the time between screen clears in persistence mode. Times are in seconds. Valid times are: 0.5, 2, 5, 15, 30, 90 and continuous other values sent will be rounded.

This query returns the time between screen clears in persistence mode.

Command Syntax: :DISPlay:PERSTime {0.5 | 2 | 5 | 15 | 30 | 90 | CONTinuous}

Example: :DISPlay:PERSTime 30

Query syntax: :DISPlay:PERSTime?

Returned Format: :DISPlay:PERSTime {0.5 | 2 | 5 | 15 | 30 | 90 | CONTinuous}

Name: **REFerenceTRace**

Type: Command, Query

Function: This command is used to turn on and off various reference traces on the display. Remember that there are three traces per channel pair available so that this command is mutually exclusive with the TRace command.

Attempting to turn on four traces will result in an error and one of the other traces being turned off. The new reference trace asked for will be turned on.

This query is used to determine whether a particular reference trace is turned on or off.

Command Syntax: :DISPlay:REFerenceTRace{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B} {numeric | OFF | ON}

Example: :DISPlay:REFerenceTRace2B ON

Query syntax: :DISPlay:REFerenceTRace{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B}?

Returned Format: :DISPlay:REFerenceTRace{1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B} {OFF | ON}

Name: **TRace**

Type: Command, Query

Function: This command is used to turn on and off various traces on the display. Remember that there are three traces per channel pair available so that this command is mutually exclusive with the REFerenceTRace command.

Attempting to turn on four traces will result in an error and one of the other traces being turned off. The new trace asked for will be turned on.

This query is used to determine whether a particular trace is turned on or off.

Command Syntax: :DISPlay:TRace{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B} {numeric | OFF | ON}

Example: :DISPlay:TRace3B ON

Query syntax: :DISPlay:TRace{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B}?

Returned Format: :DISPlay:TRace{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B} {OFF | ON}

Name: **TRACEBrightness**

Type: Command, Query

Function: This command is used to set the brightness of the traces on the screen display. The brightness level can be set from 0 to 15. A brightness level of 0 means off.

This query returns the current brightness of the screen traces.

Command Syntax: :DISPlay:TRACEBrightness {numeric}

Example: :DISPlay:TRACEBrightness 12

Query syntax: :DISPlay:TRACEBrightness?

Returned Format: :DISPlay:TRACEBrightness {numeric}

Name: **TRACEDotjoin**

Type: Command, Query

Function: This command is used to turn the dot join function On and Off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the dot join function.

Command Syntax: :DISPlay:TRACEDotjoin {numeric | OFF | ON}

Example: :DISPlay:TRACEDotjoin ON

Query syntax: :DISPlay:TRACEDotjoin?

Returned Format: :DISPlay:TRACEDotjoin {0 | 1}

Name: **XMAG**

Type: Command, Query

Function: This command is used to control the X Magnification of the screen display. It is used to set an expansion factor or to turn X Mag off. Allowable expansion factors are 2, 5 and 10, other values are rounded. Off and a factor of 1 mean the same thing.

This query returns the current state of the X Mag function.

Command Syntax: :DISPlay:XMAG {OFF | 1 | 2 | 5 | 10}

Example: :DISPlay:XMAG 5

Query syntax: :DISPlay:XMAG?

Returned Format: :DISPlay:XMAG {OFF | 1 | 2 | 5 | 10}

Name: **XSHift**

Type: Command, Query

Function: This command is used to shift all displayed traces horizontally with respect to the graticule. The numeric value is screen divisions with the permissible range of 0 to 10 divisions. 5 means that the trace in centered.

This query returns the amount of X shift currently applied to the trace display.

Command Syntax: :DISPlay:XSHift {numeric}

Example: :DISPlay:XSHift 3.2

Query syntax: :DISPlay:XSHift?

Returned Format: :DISPlay:XSHift {numeric}

Name: **XY**

Type: Command, Query

Function: This command is used to turn the XY display function Off and On. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the XY display function

Command Syntax: :DISPlay:XY {numeric | OFF | ON}

Example: :DISPlay:XY ON

Query syntax: :DISPlay:XY?

Returned Format: :DISPlay:XY {0 | 1}

Name: **XYPERSBrightness**

Type: Command, Query

Function: This command is used to set the brightness of the XY persisted display. The brightness level can be set from 0 to 15. A brightness level of 0 means off.

This query returns the current brightness of the XY persisted display.

Command Syntax: :DISPlay:XYPERSBrightness {numeric}

Example: :DISPlay:XYPERSBrightness 9

Query syntax: :DISPlay:XYPERSBrightness?

Returned Format: :DISPlay:XYPERSBrightness {numeric}

The LIMits Subsystem is used for controlling all aspects of the instrument's limits testing system.

COMMANDS

:LIMits
- :DISPlay
- :LOWer
- :MODE
- :PlotonFAIL
- :UPper

Name: **DISPlay**

Type: Command, Query

Function: This command is used to determine whether or not limit traces are displayed. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the state of the limits display.

Command Syntax: :LIMits:DISPlay {numeric | ON | OFF}

Example: :LIMits:DISPlay ON

Query syntax: :LIMits:DISPlay?

Returned Format: :LIMits:DISPlay{1 | 0}

Name: **LOWer**

Type: Command

Function: This command is used to define a lower limit for the limits detection routines. When this command is asserted, the current cursor trace becomes the lower limit.

Command Syntax: :LIMits:LOWer

Example: :LIMits:LOWer

Name: **MODE**

Type: Command, Query

Function: This command is used to set the limits testing mode to either Off, On or stop-on-fail (FAIL).

This query returns the current limits testing mode

Command Syntax: :LIMits:MODE {OFF | ON | FAIL}

Example: :LIMits:MODE FAIL

Query syntax: :LIMits:MODE?

Returned Format: :LIMits:MODE {OFF | ON | FAIL}

Name: **PlotonFAIL**

Type: Command, Query

Function: This command is used to set the plot-on-fail mode of the limits test function.

This query returns the current mode of the limits test plot on fail function.

Command Syntax: :LIMits:PlotonFAIL{OFF | ON}

Example: :LIMits:PlotonFAIL ON

Query syntax: :LIMits:PlotonFAIL?

Returned Format: :LIMits:PlotonFAIL{0 | 1}

Name: **UPper**

Type: Command

Function: This command is used to define an upper limit for the limits detection routines. When this command is asserted, the current cursor trace becomes the upper limit.

Command Syntax: :LIMits:UPper

Example: :LIMits:UPper

The MEMory Subsystem is used for controlling the instrument's trace memories.

COMMANDS

:MEMory
- :CLeaR
- :RECall
- :SAVE

Name: **CLeaR**

Type: Command

Function: This command clears the specified memory.

Command Syntax: :MEMory:CLeaR{MEMory1 | MEMory2 | MEMory3 | MEMory4 | MEMory5 | MEMory6 | MEMory7 | MEMory8 | MEMory9 | MEMory10 | MEMory11 | MEMory12 | MEMory13 | MEMory14 | MEMory15 | MEMory16}

Example: :MEMory:CLeaR MEMory4

Name: **RECall**

Type: Command

Function: This command recalls a trace from a memory to a reference trace. The recalled trace may or not be displayed depending on the state of the DISPlay:TRace command.

Command Syntax: :MEMory:RECall{MEMory1 | MEMory2 | MEMory3 | MEMory4 | MEMory5 | MEMory6 | MEMory7 | MEMory8 | MEMory9 | MEMory10 | MEMory11 | MEMory12 | MEMory13 | MEMory14 | MEMory15 | MEMory16}, {REFerenceTRace1A | REFerenceTRace1B | REFerenceTRace2A | REFerenceTRace2B | REFerenceTRace3A | REFerenceTRace3B | REFerenceTRace4A | REFerenceTRace4B}

Example: :MEMory:RECall MEMory14,REFerenceTRace1A

Name:	**SAVE**
Type:	Command
Function:	This command saves either an acquired trace (TRace) or a reference trace (REFerenceTRace) to a specified trace memory. The command has two parts a source and a destination.
Command Syntax:	:MEMory:SAVE{TRace1A | TRace1B | TRace2A | TRace2B | TRace3A | TRace3B | TRace4A | TRace4B | REFerenceTRace1A | REFerenceTRace1B | REFerenceTRace2A | REFerenceTRace2B | REFerenceTRace3A | REFerenceTRace3B | REFerenceTRace4A | REFerenceTRace4B}, {MEMory1 | MEMory2 | MEMory3 | MEMory4 | MEMory5 | MEMory6 | MEMory7 | MEMory8 | MEMory9 | MEMory10 | MEMory11 | MEMory12 | MEMory13 | MEMory14 | MEMory15 | MEMory16}
Example:	:MEMory:SAVE TRace2B, MEMory14

The MENU Subsystem is used for controlling the menu transparency.

COMMANDS
:MENU
  :TRANSparency

Name:	**TRANSparency**
Type:	Command, query
Function:	This command is used to set whether or not menus are transparent. ON means that menus are transparent.
Command Syntax:	**:**MENU:TRANSparency {numeric | OFF | ON}
Example:	:MENU:TRANSparency ON
Query Syntax:	:MENU:TRANSparency?
Example:	:MENU:TRANSparency {OFF | ON}

PLOT Subsystem

The PLOT Subsystem is used for controlling all aspects of the instrument's plot performance.

COMMANDS

:PLOT
- :BAUD
- :BPC
- :DEst
- :GRaticule
- :HAND
- :LABELsdatecursor
- :MOde
- :PARity
- :PEnchange
- :PERStype
- :STopBits

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Name: **BAUD**

Type: Command, Query

Function: This command is used to set the baud rate for RS423 plots and is only valid when a GPIB or RS423 pod is fitted to the instrument. Valid baud rates are 110, 300, 600, 1200, 2400, 4800 and 9600. Any other vales sent will be rounded.

This query returns the current baud rate for RS423 plots.

Command Syntax: :PLOT:BAUD {110 | 300 | 600 | 1200 | 2400 | 4800 | 9600}

Example: :PLOT:BAUD 9600

Query syntax: :PLOT:BAUD?

Returned Format: :PLOT:BAUD {110 | 300 | 600 | 1200 | 2400 | 4800 | 9600}

Name: **BPC**

Type: Command, Query

Function: This command is used to set the number of data bits per byte sent for RS423 plots and is only valid when a GPIB or RS423 pod is fitted to the instrument.. Valid numbers are 7 or 8. other values will be rounded.

This query returns the number of data bits per byte sent for RS423 plots.

Command Syntax: :PLOT:BPC {numeric}

Example: :PLOT:BPC 7

Query syntax: :PLOT:BPC?

Returned Format: :PLOT:BPC {numeric}

Name: **DEst**

Type: Command, Query

Function: This command sets the destination for plots. The internal option is only valid if an internal plotter - either color or thermal- is fitted.

This query returns the current plot desination.

Command Syntax: :PLOT:DEst {INTernal | GPIB | RS423}

Example: :PLOT:DEst INTernal

Query syntax: :PLOT:DEst?

Returned Format: :PLOT:DEst {INTernal | GPIB | RS423}

Name: **GRaticule**

Type: Command, Query

Function: This command sets the graticule type to be plotted. It can be either solid lines, broken lines or turned off altogether.

This query returns the current state of the plot graticule function

Command Syntax: :PLOT:GRaticule {OFF | SOLID | BROKEN}

Example: :PLOT:GRaticule BROKEN

Query syntax: :PLOT:GRaticule?

Returned Format: :PLOT:GRaticule {OFF | SOLID | BROKEN}

Name: **LABELsdatecursor**

Type: Command, Query

Function: This command is used to turn trace labels, date stamps and cursors on plots on or off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the state of the plot labels, date and cursor function.

Command Syntax: :PLOT:LABELsdatecursor {numeric | ON | OFF}

Example: :PLOT:LABELsdatecursor ON

Query syntax: :PLOT:LABELsdatecursor?

Returned Format: :PLOT:LABELsdatecursor {numeric | 1 | 0}

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Name: **HAnd**

Type: Command, Query

Function: This command is used to set the handshaking used for RS423 plots and is only valid when a GPIB or RS423 pod is fitted to the instrument. Handshaking can be set to none, XON/XOFF -software- or RTS/CTS -hardware-.

This query returns the handshaking arrangement to be used for RS423 plots.

Command Syntax: :PLOT:HAnd {None | XONxoff | RTScts}

Example: :PLOT:HAnd RTScts

Query syntax: :PLOT:HAnd?

Returned Format: :PLOT:HAnd {None | XONxoff | RTScts}

Name: **MOde**

Type: Command, Query

Function: This command is used to set the plot mode to either Auto or single.

This query returns the current plot mode.

Command Syntax: :PLOT:MOde {AUTO | SINgle}

Example: :PLOT:MOde SINgle

Query syntax: :PLOT:MOde?

Returned Format: :PLOT:MOde {AUTO | SINgle}

Name: **PARity**

Type: Command, Query

Function: This command is used to set the parity used for RS423 plots and is only valid when a GPIB or RS423 pod is fitted to the instrument. Parity can be set to None, even, odd, mark or space.

This query returns the parity setting to be used for RS423 plots.

Command Syntax: :PLOT:PARity {None | Even | Odd | Mark | Space}

Example: :PLOT:PARity None

Query syntax: :PLOT:PARity?

Returned Format: :PLOT:PARity {None | Even | Odd | Mark | Space}

Name: **PERStype**

Type: Command, Query

Function: This command sets the style of persisted trace plots. The trace can either be plotted as dotted or solid lines or not plotted at all.

This query returns the plot style of persisted traces.

Command Syntax: :PLOT:PERStype {Dots | Line | OFF}

Example: :PLOT:PERStype Dots

Query syntax: :PLOT:PERStype?

Returned Format: :PLOT:PERStype {Dots | Line | OFF}

Name: **PEnchange**

Type: Command

Function: This command is only valid when an internal color plotter is fitted to the instrument. When asserted, this command causes the pen carriage to rotate to the next pen position. This is for use when it is required to replace the pens.

Command Syntax: :PLOT:PEnchange

Example: :PLOT:PEnchange

Name: **STopBits**

Type: Command, Query

Function: This command is used to set the number of stop bits per byte for RS423 plots and is only valid when a GPIB or RS423 pod is fitted to the instrument. Either 1 or 2 stop bits can be sent. Other values will be rounded.

This query returns the number of stop bits to be used for RS423 plots.

Command Syntax: :PLOT:STopBits {numeric}

Example: :PLOT:STopBits 2

Query syntax: :PLOT:STopBits?

Returned Format: :PLOT:STopBits {numeric}

The POSTStore Subsystem is used for controlling all aspects of the instrument's poststorage trace manipulations.

COMMANDS

:POSTStore
- :CAPtureandREPeat
- :FILter
- :FILterFACtor
- :INITialize
- :INTegrate
- :INTegrateScaling
- :INVert
- :REStore
- :XMAg
- :XSHift
- :YMAg
- :YSHift

Name: **CAPtureandREPeat**

Type: Command

Function: This command is used to perform a new acquisition and repeat a previously performed post storage manipulation sequence. This command is only valid if some post storage manipulation has been preformed.

Command Syntax: :POSTStore:CAPtureandREPeat

Example: :POSTStore:CAPtureandREPeat

See Also: INITiaize, REPeat

Name: **FILter**

Type: Command

Function: This command is used to perform a filter on the cursor trace using the filter frequency/factor selected by the filterfactor command.

Command Syntax: :POSTStore:FILter

Example: :POSTStore:FILter

See Also: FILterFactor

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Name: **FILterFACtor**

Type: Command, Query

Function: This command is used to set the filter factor used by the FILter command. One of 6 filter factors; 1 - 6 can be selected. The actual filter frequency depends on the timebase rate.

This query returns the filter factor set to be used by the FILter command.

Command Syntax: :POSTStore:FILterFACtor {numeric}

Example: :POSTStore:FILterFACtor 5

Query syntax: :POSTStore:FILterFACtor?

Returned Format: :POSTStore:FILterFACtor {numeric}

Note: *For filter frequencies see section 3.26.1*

Name: **INITialize**

Type: Command

Function: This command is used to clear any post storage manipulation sequence from the instrument's memory. This is used to clear the sequence used by the CAPtureandREPeat command.

This command may also be spelt INITialise. Both forms will be recognized by the DSO.

Command Syntax: :POSTStore:INITialize

Example: :POSTStore:INITialize

See Also: CAPtureandREPeat, REPeat

Name: **INTegrateScaling**

Type: Command, Query

Function: This command is used to set the scaling factor applied to trace integration when the integrate command is used.

This query returns the current integration factor to be used by the integrate command.

Command Syntax: :POSTStore:INTegrateScaling {x0.1 | x0.2 | x0.5 | x1}

Example: :POSTStore:INTegrateScaling x0.5

Query syntax: :POSTStore:INTegrateScaling?

Returned Format: :POSTStore:INTegrateScaling {x0.1 | x0.2 | x0.5 | x1}

Name: **INTegrate**

Type: Command

Function: This command is used to perform an integration on the stored cursor trace. The scaling factor for the integration is set by the INTegrateScaling command

Command Syntax: :POSTStore:INTegrate

Example: :POSTStore:INTegrate

See Also: INTegrateScaling

Name: **INVert**

Type: Command

Function: This command is used to invert the stored cursor trace on the display.

Command Syntax: :POSTStore:INVert

Example: :POSTStore:INVert

Name: **REPeat**

Type: Command

Function: This command is used to repeat a poststorage manipulation sequence without recapturing a signal. It would typically be used immediately after acquiring a single shot capture.

Command Syntax: :POSTStore:REPeat

Example: :POSTStore:REPeat

See Also: CAPtureand REPeat, INITialize

Name: **REStore**

Type: Command

Function: This command is used to restore the cursor trace to its original stored settings, i.e remove the effects of any post store manipulation

Command Syntax: :POSTStore:REStore

Example: :POSTStore:REStore

Name: **XMAg**

Type: Command, Query

Function: This command is used to set a horizontal magnification factor to the stored cursor trace. A magnification factor of between 1 and 4 is valid.

This query returns the current horizontal magnification factor applied to the stored cursor trace.

Command Syntax: :POSTStore:XMAg {numeric}

Example: :POSTStore:XMAg 1.7

Query syntax: :POSTStore:XMAg?

Returned Format: :POSTStore:XMAg {numeric}

Name: **XSHift**

Type: Command, Query

Function: This command is used to shift the stored cursor trace horizontally. The value is sent in screen divisions from the trace's non shifted position. The valid shift range is ±5 divisions.

This query returns the current horizontal shift in screen divisions applied to the cursor trace.

Command Syntax: :POSTStore:XSHift {numeric}

Example: :POSTStore:XSHift 7.4

Query syntax: :POSTStore:XSHift?

Returned Format: :POSTStore:XSHift {numeric}

Name:	**YMAg**
Type:	Command, Query
Function:	This command is used to set a vertical magnification factor to the stored cursor trace. A magnification factor of between 0.02 and 4 is valid. This query returns the current vertical magnification factor applied to the stored cursor trace.
Command Syntax:	:POSTStore:YMAg {numeric}
Example:	:POSTStore:YMAg 1.2
Query syntax:	:POSTStore:YMAg?
Returned Format:	:POSTStore:YMAg {numeric}

Name:	**YSHift**
Type:	Command, Query
Function:	This command is used to shift the stored cursor trace vertically. The value is sent in screen divisions from the trace's non shifted position. The valid shift range is ±12 divisions. This query returns the current vertical shift in screen divisions applied to the cursor trace.
Command Syntax:	:POSTStore:YSHift{numeric}
Example:	:POSTStore:YSHift 4
Query syntax:	:POSTStore:YSHift?
Returned Format:	:POSTStore:YSHift{numeric}

The REFerenceTRace Subsystem is used for saving traces to the instrument's reference traces.

COMMANDS

:REFerenceTRace
  :SAVE
  :SAVEALL

Name:	**SAVE**
Type:	Command
Function:	This command copies either an acquired trace (TRace) or a reference trace (REFerenceTRace) to a specified reference trace. The command has two parts a source and a destination.
Command Syntax:	:REFerenceTRace:SAVE {TRace1A | TRace1B | TRace2A | TRace2B | TRace3A | TRace3B | TRace4A | TRace4B | REFerenceTRace1A | REFerenceTRace1B | REFerenceTRace2A | REFerenceTRace2B | REFerenceTRace3A | REFerenceTRace3B | REFerenceTRace4A | REFerenceTRace4B}, {REFerenceTRace1A | REFerenceTRace1B | REFerenceTRace2A | REFerenceTRace2B | REFerenceTRace3A | REFerenceTRace3B | REFerenceTRace4A | REFerenceTRace4B}
Example:	:REFerenceTRace:TRace1A, REFerenceTRace1B

Name:	**SAVEALL**
Type:	Command
Function:	This command copies all acquired traces (TRace1A to 4B) to REFerenceTRaces 1A to 4B.
Command Syntax:	:REFerenceTRace:SAVEALL
Example:	:REFerenceTRace:SAVEALL

The ROOT commands are various single level commands for controlling DSO functions.

COMMANDS
:ABORT
:ALL?
:AUTosetup
:BandwidthLimit
:BEEP
:DATE
:ECHOandprompt
:HELP?
:HELPEXT
:KEYclick
:LER?
:LTER?
:MENU
:PLOT
:SER?
:TEXT
:TIME

Name: **ABORT**

Type: Command

Function: This command has the same function as the front panel Abort key except that it does not return the instrument to local control. It is used to stop an AUTOSETUP or a PLOT.

Command syntax: :ABORT

Example: :ABORT

Name: **ALL?**

Type: Query

Function: This query is used to determine the complete instrument status and setup by executing all possible queries except any from the COMMON subset and the following:

ALL?,
:SETup:Selection?,
:SYStem HEADER?,
:SYStem:LONGform,
:TRANsfer:ACQuisition,
:TRANsfer:DISPlay,
:TRANsfer:REFTR,
:TRANsfer:REFMem,
:GPIB ADDress
:DATE
:TIME
:TEXT

The returned data can be saved and sent to the DSO as a command to return the instrument to a particular status. This query has a similar function to the Setup commands but has the advantage that the data can be easily examined and understood as the answers are textual and are as described under the relevant queries.

Query syntax: :ALL?

Returned Format: :

Name: **AUTosetup**

Type: Command

Function: This command has the same function as the front panel Auto Setup key. The pre Autosetup state can be recovered using the :AUTosetup:RESTore command.

Command syntax: :AUTosetup

Example: :AUTosetup

Name: **BandwidthLimit**

Type: Command, Query

Function: This command is used to set the bandwidth of all the input channels to either 20MHz or their full range.

This query returns the bandwidth limit state of the input channels.

Command syntax: :BandwidthLimit {NOne | TWEnty}

Example: :BandwidthLimit TWEnty

Query syntax: :BandwidthLimit?

Returned Format: :BandwidthLimit {NOne | TWEnty}

Name: **BEEP**

Type: Command

Function: This command is used to sound the instrument's internal beeper.

The length of the beep can be varied from approximately 1 to 15 seconds by varying the numeric field from 1 to 15.

Command syntax: :BEEP {numeric}

Example: :BEEP 7

Name: **DATE**

Type: Command, Query

Function: This command is used to set the instrument's internal clock with the correct date.

This query is used to examine the current setting of the instrument's internal clock.

Command Syntax: :DATE{numeric}{JANuary | FEBruary | MARch | APRil | MAY | JUNe | JULy | AUGust | SEPtember |OCTober| NOVember | DECember} {numeric}

Example: :DATE 14 JULy 1991

Query syntax: :DATE?

Returned Format: :DATE{numeric}{JANuary | FEBruary | MARch | APRil | MAY | JUNe | JULy | AUGust | SEPtember | OCTober | NOVember | DECember} {numeric}

Notes: *The DSO can accept dates in either MM-DD-YY or DD-MM-YY format but will output dates in the format set by the DATE:FORMAT command.*

Name: **HELP?**

Type: Query

Function: This query returns a list of all commands with all their possible arguments.

This will consist of about 4k of alphanumeric data.

Query syntax: :HELP?

Returned Format: :HELP {list of all commands}

Name: **KEYclick**

Type: Command, Query

Function: This command is used to turn the keyclick feature off and on.

This query

Command syntax: :KEYclick{numericl OFF | ON}

Example: :KEYclick ON

Query syntax: :KEYclick?

Returned Format: :KEYclick {1 | 0 }

Name: **LER?**

Type: Query

Function: This query returns the Status of the Local Event Register (LER). The value returned will be either 1 or 0. See figure 5.2.

1 means that the instrument has been switched from remote to local operation since this query was last sent, i.e. the front panel abort key has been pressed.

0 means that the instrument has not been switched from remote to local operation since this command was last sent.

Sending this query will reset the LER to 0 once the value has been read.

Query syntax: :LER?

Returned Format: :LER {1 | 0}

Name: **LTER?**

Type: Query

Function: This query returns the status of the Limit Test Event Register (LTER). See figure 5.2. The value returned will be either 1 or 0. 1 means that Limits testing has failed since this query was last sent. 0 means that Limits testing has passed.

The LTER is reset to 0 once the value has been read by this query.

Query syntax: :LTER?

Returned Format: :LTER {0 | 1}

5

Name: **MENU**

Type: Command, Query

Function: This command is used to change the DSO display to any of the menus by sending one of the menu titles listed below. The display can be returned to the normal trace display by sending OFF.

This query returns the current state of the display and will be either a menu title or OFF.

Menu Titles

OFF
DISPlay Master menu
CAPture Master menu
Save and Recall Master menu
DISPlay Intensity menu
TV Trigger menu
TRIGger Setup menu
PROBe Gain selection menu
INSTrument Setups menu
CURrent Status
PLOT configuration menu

SET Time AND Date menu
RS423 Control port menu
TRACe MATH menu
50OHM select menu
I/O Master menu
RS423 Plotter port menu
BANDWidth & calibration menu
CURSor Measurements menu
TRACe MANIPulation menu
PERSistence menu
VIEW Trace menu
GPIB menu
REF Trace Save menu
MEMORY Save menu
MEMORY Recall menu
LIMITS Test menu
MATH Master menu
FUNCtion menu
AVeraGing menu
Setup Status menu

Command Syntax: :MENU {menu title}

Example: :MENU CAPtureMastermenu

Query syntax: :MENU?

Returned Format: :MENU {menu title}

Name: **PLOT**

Type: Command

Function: This command has the same function as the front panel Plot key. It will initiate a plot of the current screen display using the parameters set using the :PLOT commands.

Command syntax: :PLOT

Example: :PLOT

Name: **SER?**

Type: Query

Function: This query returns the status of the Stored Event Register (SER). See figure 5.2. The value returned will be either 1 or 0. 1 means that acquisition is complete and a trace is stored on the display and 0 means that no trace is currently stored on the display. Do not confuse this with traces stored in the trace memories.

Query syntax: :SER?

Returned Format: :SER 0

Name: **TIME**

Type: Command, Query

Function: This command is used to set the instrument's internal clock with the correct time. The time is sent in the hours, minutes, seconds form.

This query is used to examine the current setting of the instrument's internal clock.

Command Syntax: :TIME{numeric, numeric, numeric}

Example: :TIME 16,45,00

Query syntax: :TIME?

Returned Format: :TIME{numeric, numeric, numeric}

Name: **TEXT**

Type: Command, Query

Function: This command allows the user to add annotation to the screen prior to plotting. Text can be added to any line of the display and will overwrite any existing text. Each line is 31 characters long.

Line 1 is the top line and line 15 is the bottom line. Line 3 normally contains numeric key 2 information and line 15 normally contains numeric key 8 information.

The TEXT* version of this command can be used to put the same text on every line. If "" is sent (2 quote marks), this clears all text from the display.

To restore the normal text display use the MENU command.

This query returns the text on the specified display line.

Command syntax: :TEXT{numeric} "{string}"

Example: :TEXT4 " Text on line four"

Query syntax: :TEXT1?

Returned Format: :TEXT{numeric} "{string}"

The SETup Subsystem is used for controlling the instrument's setup memories.

COMMANDS

:SETup
  :RECALL
  :SAVE

Name: **RECALL**

Type: Command

Function: This command command recalls an instrument setup from a selected setup memory number. The recalled setup replaces the current instrument setup.

Command Syntax: :SETup:RECALL{1 | 2 | 3 | 4 | 5 | 6 | 7 | 8}

Example: :SETup:RECALL 2

Name: **SAVE**

Type: Command

Function: This command saves the current instrument setup to the specified setup memory.

Command Syntax: :SETup:SAVE{1 | 2 | 3 | 4 | 5 | 6 | 7 | 8}

Example: :SETup:SAVE 4

SYStem Subsystem

The SYStem Subsystem is used for controlling the GPIB error reporting and format.

COMMANDS

:SYStem
- :ERRor
- :ERRorCLear
- :HEADer
- :LONGform

Name: **ERRor**

Type: Query

Function: This query returns the earliest entry in the error list created by the instrument. There are two forms of the command numeric or string. Either the word STRING, the word NUMBER or no parameter can be specified. If STRING is specified, the DSO will return the error numbers together with their descriptions. If NUMBER or no parameter is specified, the error number only is returned .

The errors returned depend on the error type as shown in the table below:

No. Error

0 No Error

Special Purpose Errors
- 1 command failed
- 2 invalid mode
- 5 argument rounded

Remote Command Processor/Parser Errors
- 10 command not known
- 11 argument not known
- 12 argument expected
- 13 string expected
- 14 query only
- 15 command only
- 16 illegal data
- 17 data expected
- 18 data not expected
- 19 excessive data
- 20 invalid selection
- 21 input too long

I/O Errors:
- 55 I/O OPTION POD FAULT

Horizontal Errors
- 60 B TIMEBASE FORCED BY A
- 61 A TIMEBASE FORCED BY B
- 62 AVERAGING DISABLED IN ROLL
- 63 L.TEST AVAILABLE IN REFR ONLY

Warnings
- 90 WARNING:NO TRACE SELECTED
- 91 WARNING:NO Y TRACE VISIBLE
- 94 WARNING:INFINITE PERSISTENCE
- 95 WARNING:VALUE FORCED INTO RANGE
- 96 WARNING:CALC ALREADY SELECTED
- 99 WARNING:3 TRACES ONLY/CH PAIR

Post Storage Manipulation Errors
- 100 POST STORAGE:TRACE NOT STORED
- 101 POST STORAGE:NO TRACE SELECTED
- 102 POST STORAGE: RESULT OFF SCREEN
- 103 POST STORAGE: ALREADY FILTERED
- 104 POST STORAGE: NOTHING TO REPEAT

Cursor Errors
- 105 DATUM LOCKED TO GND IN ABS MODE

Plotter Errors
- 110 NO PLOTTER FITTED

Save And Recall Errors
- 120 SETUP EMPTY
- 121 SETUP CORRUPT
- 125 REF MEMORY EMPTY
- 126 REF MEMORY CORRUPT
- 127 REF TRACE EMPTY
- 128 REF TRACE CORRUPT

Display Task Errors
- 130 ROLL:WILL MAGNIFY WHEN STORED
- 135 NO ADD WHEN HELD

Trigger Errors
- 140 TV TRIG:NO AUTO TRIGGER
- 141 TV TRIG:SLOPE DISABLED
- 142 TV TRIG:AC COUPLING ONLY
- 143 B TRIG:NO AUTO TRIGGER
- 144 B TRIG:NOT IN USE
- 145 LINE TRIG:AC hf-rej ONLY

Roll Mode Errors
- 150 NO ROLL IN DUAL TIMEBASE
- 151 NO AVERAGE IN ROLL

General Errors
- 155 50 OHM: NO AC COUPLING
- 160 NO DESTINATION

180 AUTOSETUP ALREADY IN PROGRESS
190 DATA CHECKSUM FAILURE
GPIB errors
200 GPIB deadlock
201 GPIB interrupted
202 GPIB unterminated
203 GPIB dcas
204 GPIB ifc
205 GPIB unexpected EOI
206 GPIB received GET

When an error has been examined using this command it is removed from the list.

Query syntax: :SYStem:ERRor? {NUMBER | STRING}

Returned Format: :SYStem:ERRor {NUMBER | STRING}

Name: **ERRorCLear**

Type: Command

Function: This command is used to clear the error list held by the instrument when errors such as invalid commands are received.

Command Syntax: :SYStem:ERRorCLear

Example: :SYStem:ERRorCLear

Name: **HEADer**

Type: Command, Query

Function: This command is used to turn the Response Header part of a query reply on or off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query determines whether a Response Header is included as part of a reply to a query.

Command Syntax: :SYStem:HEADer{numeric | ON | OFF}

Example: :SYStem:HEADer OFF

Query syntax: :SYStem:HEADer?

Returned Format: :SYStem:HEADer{ON | OFF}

Name: **LONGform**

Type: Command, Query

Function: This command determines whether the DSO resopnds to queries with the minimum format of commands or the longform (complete form) of commands.

The DSO will always accept either form of command as an input.

Numeric values may be sent, 0 is interpreted as minimum and any other number is interpreted as Longform.

This query returns the state of the command format to be sent by the DSO.

Command Syntax: :SYStem:LONGform{numeric | ON | OFF}

Example: :SYStem:LONGform ON

Query syntax: :SYStem:LONGform?

Returned Format: :SYStem:LONGform{ON | OFF}

TRANsfer Subsystem

The TRANsfer Subsystem is used for controlling all aspects of trace and setup data transfer to and from the DSO.

COMMANDS

:TRANsfer
- :ACQuisition
  - :ALL
  - :DATAonly
- :DISPlay
  - :ALL
  - :DATAonly
- :FORMat
- :LIMIT
  - :LOWer
  - :UPper
- :MEMory
  - :ALL
  - :DATAonly
- :RADIX
- :REFerenceTRace
  - :ALL
  - :DATAonly
- :SETup
- :WindowSTArt
- :WindowSTOp

The :ALL and :DATAonly parts of the command header function in the same way for each of the commands; :ACQuisition, :DISPlay, :LIMIT, :MEMory and :REFerenceTRace.

The functions of :ALL and :DATAonly are described below and should be read in conjunction with the relevant command.

Name: **ALL**

Type: Command, Query

Function: This command is used in conjunction with the TRANSfer commands to transfer data to the DSO from a host computer.

This query is used in conjunction with the TRANSfer commands to transfer data from the DSO to a host computer.

Command Syntax: :TRANsfer:{command}:ALL {Bulk data}

Example: :TRANsfer:ACQuisition 1A :ALL {bulk data}

Query syntax: :TRANsfer:{command}:ALL?

Returned Format: :TRANsfer:{command}:ALL {bulk data}

See also: DATAonly, ACQuisition, DISPlay, LIMIT, MEMory, REFerenceTRace, Bulk Transfers 5.2.6.

Name: **DATAonly**

Type: Command, Query

Function: This command is used in conjunction with the TRANSfer commands to transfer data to the DSO from a host computer.

This query is used in conjunction with the TRANSfer commands to transfer data from the DSO to a host computer.

Command Syntax: :TRANsfer:{command} :DATAonly {bulk data}

Example: :TRANsfer:ACQuisition1A :DATAonly {bulk data}

Query syntax: :TRANsfer:{command} :DATAonly?

Returned Format: :TRANsfer:{command} :DATAonly {bulk data}

See also: ALL, ACQuisition, DISPlay, LIMIT, MEMory, REFerenceTRace, Bulk Transfers 5.2.6.

Name: **ACQuisition**

Type: Command, Query

Function: This command is used to transfer trace data from a host computer to an acquisition store in the instrument. The store number can be 1A, 1B, 2A, 2B, 3A, 3B, 4A or 4B. The bulk data must have been originally generated by and transferred from the DSO.

This query is used to transfer trace data from an acquisition store in the DSO to a host computer. The store number can be 1A, 1B, 2A, 2B, 3A, 3B, 4A or 4B.

Command Syntax: :TRANsfer:ACQuisition{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B} :{ALL | DATAonly} {bulk data}

Example:

:TRANsfer:ACQuisition1A:ALL {bulk data}

Query syntax: :TRANsfer:ACQuisition{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B}:{ALL | DATAonly}?

Returned Format: :TRANsfer:ACQuisition{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B} :{ALL | DATAonly} {bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

Name: **DISPlay**

Type: Command, Query

Function: This command is used to transfer trace data from a host computer to a display on the instrument. The display number can be 1A, 1B, 2A, 2B, 3A, 3B, 4A or 4B. The bulk data must have been originally generated by and transferred from the same instrument type.

This query is used to transfer trace data from a display store in the DSO to a host computer.

Command Syntax: :TRANsfer:DISPlay{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B} :{ALL | DATAonly} {bulk data}

Example: :TRANsfer:DISPlay2B:{ALL | DATAonly} {bulk data}

Query syntax: :TRANsfer:DISPlay{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B} :{ALL | DATAonly}?

Returned Format: :TRANsfer:DISPlay{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B} :{ALL | DATAonly} {bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

Name: **FORMat**

Type: Command, Query

Function: This command is used to define the format of data transmitted from the instrument and can either be raw data or pure text.

Raw means Definite Length Arbitrary Response Data. See section 5.2.6

Text means Numeric response data NR1. See section 5.2.6

This query returns the current format to be used for data transmission

Command Syntax: :TRANsfer:FORMat {TEXT | RAW}

Example: :TRANsfer:FORMat TEXT

Query syntax: :TRANsfer:FORMat?

Returned Format: :TRANsfer:FORMat {RAW | TEXT}

Name: **LIMIT:LOWer**

Type: Command, Query

Function: This command is used to transfer the lower limit trace data from a host computer to the instrument. The limit data must have been originally generated by and transferred from the DSO.

This query is used to transfer the lower limit trace data from the DSO to a host computer.

Command Syntax: :TRANsfer:LIMIT:LOWer {bulk data}

Example: :TRANsfer:LIMIT:LOWer {bulk data}

Query syntax: :TRANsfer:LIMIT:LOWer?

Returned Format: :TRANsfer:LIMIT:LOWer {bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

Name: **LIMIT:UPper**

Type: Command, Query

Function: This command is used to transfer the lower limit trace data from a host computer the instrument. The limit data must have been originally generated by and transferred from the DSO.

This query is used to transfer the lower limit trace data from the DSO to a host computer.

Command Syntax: :TRANsfer:LIMIT:UPper {bulk data}

Example: :TRANsfer:LIMIT:UPper {bulk data}

Query syntax: :TRANsfer:LIMIT:UPper?

Returned Format: :TRANsfer:LIMIT:UPper {bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

Name: **MEMory**

Type: Command, Query

Function: This command is used to transfer trace data from a host computer to a trace memory in the instrument. There are 16 memories from 1 to 16. The bulk data must have been originally generated by and transferred from the DSO.

This query is used to transfer trace memory data from a memory in the DSO to a host computer.

If an unused memory is requested, an error will be generated and the data sent will be zeros.

Command Syntax: :TRANsfer:MEMory{1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16}:{ALL | DATAonly} {bulk data}

Example: :TRANsfer:MEMory14:ALL {bulk data}

Query syntax: :TRANsfer:MEMory{1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16}:{ALL | DATAonly}?

Returned Format: :TRANsfer:MEMory{1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16}:{ALL | DATAonly} {bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

Name: **RADIX**

Type: Command, Query

Function: This command is used to set the number base used for data transfer. It can be either Octal, Decimal or Hexadecimal.

This query returns the number base to be used for data transfers.

Command Syntax: :TRANsfer:RADIX{OCTal | DECimal | HEXadecimal}

Example: :TRANsfer:RADIX DECimal

Query syntax: :TRANsfer:RADIX?

Returned Format: :TRANsfer:RADIX{OCTal | DECimal | HEXadecimal}

Name: **REFerenceTRace**

Type: Command, Query

Function: This command is used to transfer trace data from a host computer to a Reference trace store in the instrument. The store number can be 1A, 1B, 2A, 2B, 3A, 3B, 4A or 4B. The bulk data must have been originally generated by and transferred from the DSO.

This query is used to transfer trace data from a reference trace in the DSO to a host computer.

If an unused memory is requested, an error will be generated and the data sent will be zeros.

Command Syntax: :TRANsfer:REFerenceTRace{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B} :{ALL | DATAonly} {bulk data}

Example: :TRANsfer:REFerenceTRace1A :DATAonly {bulk data}

Query syntax: :TRANsfer:REFerenceTRace{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B}:{ALL | DATAonly}?

Returned Format: :TRANsfer:REFerenceTRace{1A | 1B | 2A | 2B | 3A | 3B | 4A | 4B}:{ALL | DATAonly} {bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

Name: **SETup**

Type: Command, Query

Function: This command is used to transfer instrument setups from a host computer to one of the 8 setup memories on the DSO. The setup must have been originally generated by and transferred from the DSO.

This query is used to transfer instrument setups to a host computer from the DSO.

If an unused memory is requested, an error will be generated and the data sent will be zeros.

Command Syntax: :TRANsfer:SETup{1 | 2 | 3 | 4 | 5 | 6 | 7 | 8}{bulk data}

Example: :TRANsfer:SETup7{bulk data}

Query syntax: :TRANsfer:SETup{1 | 2 | 3 | 4 | 5 | 6 | 7 | 8}?

Returned Format: :TRANsfer:SETup{1 | 2 | 3 | 4 | 5 | 6 | 7 | 8}{bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

Name: **WindowSTArt**

Type: Command, Query

Function: This command is used in conjunction with the WindowSTOp command to define the portion of the trace transmitted or accepted by DATAonly transfer commands and queries.

For the whole trace, WindowSTArt should be set to 0 and WindowSTOp to 501. If only the middle two divisions are required, WindowSTArt should be 200 and WindowSTOp 299.

This query returns the byte number of the first transmitted data point of DATAonly transfers.

Command Syntax: :TRANsfer:WindowSTArt {numeric}

Example: :TRANsfer:WindowSTArt 501

Query syntax: :TRANsfer:WindowSTArt?

Returned Format: :TRANsfer:WindowSTArt {numeric}

See also: DATAonly, Bulk Transfers 5.2.6.

Name:	**WindowSTOp**
Type:	Command, Query
Function:	This command is used in conjunction with the WindowSTOp command to define the portion of the trace transmitted or accepted by DATAonly transfer commands and queries. For the whole trace, WindowSTArt should be set to 0 and WindowSTOp to 501. If only the middle two divisions are required, WindowSTArt should be 200 and WindowSTOp 299. This query returns the byte number of the last transmitted data point of DATAonly transfers.
Command Syntax:	:TRANsfer:WindowSTOp {numeric}
Example:	:TRANsfer:WindowSTOp 501
Query syntax:	:TRANsfer:WindowSTOp?
Returned Format:	:TRANsfer:WindowSTOp {numeric}
See also:	DATAonly, Bulk Transfers 5.2.6.

The TRIGger Subsystem is used for controlling the instrument's trigger system.

COMMANDS

:TRIGger
- :AGAteb
- :AUTotrig

Name:	**AGAteb**
Type:	Command, Query
Function:	This command is used to turn the A gate B trigger function on or off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON. This query returns the current state of the A gate B trigger function.
Command Syntax:	:TRIGger:AGAteb {numeric | ON | OFF}
Example:	:TRIGger:AGAteb ON
Query syntax:	:TRIGger:AGAteb?
Returned Format:	:TRIGger:AGAteb{ON | OFF}

Name:	**AUTotrig**
Type:	Command, Query
Function:	This command is used to turn auto trigger on or off, i.e. set the trigger to mode to either Auto or Normal. Numeric values may be sent, 0 is interpreted as Autotrigger OFF and any other number is interpreted as ON. This query returns the current state of the autotrigger system.
Command Syntax:	:TRIGger:AUTotrig {numeric | ON | OFF}
Example:	:TRIGger:AUTotrig ON
Query syntax:	:TRIGger:AUTotrig?
Returned Format:	:TRIGger:AUTotrig{ON | OFF}

TRIGger{A | B} Subsystem

The TRIGger{ A | B } Subsystem is used for controlling the instrument's A & B trigger systems.

COMMANDS

:TRIGger{A | B}
- :COUpling
- :DELay
- :LEVel
- :PREPost
- :PREtrig
- :SLOpe
- :SOurce
- :TVSyncpolarity
- :TVtrigger

Name: **COUpling**

Type: Command, Query

Function: This command is used to set the coupling of the trigger source for the A or B trigger system. If the trigger source is set to line then this command is not available. For high frequency reject coupling, the selection is HFREJ.

This query returns the current coupling of the trigger source for the A or B trigger system.

Command Syntax: :TRIGger{A | B | *}:COUpling {AC | DC | ACHFREJ | DCHFREJ | TV}

Example: :TRIGger{A}:COUpling AC

Query syntax: :TRIGger{A | B | *}:COUpling?

Returned Format: :TRIGger{A | B}:COUpling {AC | DC | ACHFREJ | DCHFREJ | TV}

Name: **DELay**

Type: Command, Query

Function: This command is used to set the post trigger delay time of the A or B trigger. The time is in seconds with a resolution of 5ns.

This query returns the current delay of the A or B trigger.

Command Syntax: :TRIGger{A | B | *}:DELay {numeric}

Example: :TRIGger{A}:DELay 0.055

Query syntax: :TRIGger{A | B | *}:DELay?

Returned Format: :TRIGger{A | B} :DELay{numeric}

See Also: PREPost

Name: **LEVel**

Type: Command, Query

Function: This command is used to set the trigger level for the A or B trigger system. The numeric value is in screen divisions from the source channel ground, and has a range of 8 divisions.

This query returns the current trigger level for the A or B trigger system.

Command Syntax: :TRIGger{A | B | *}:LEVel {numeric}

Example: :TRIGger{B}:LEVel 5.4

Query syntax: :TRIGger{A | B | *}:LEVel?

Returned Format: :TRIGger{A | B}:LEVel {numeric}

Name: **PREPost**

Type: Command, Query

Function: This command is used to select either pre or post trigger for the A or B trigger system.

This query returns the state of the Pre or Post trigger selection for the A or B trigger system.

Command Syntax: :TRIGger{A | B | *}:PREPost {PREtrigger | POSTtrigger}

Example: :TRIGger{B}:PREPost PREPost

Query syntax: :TRIGger{A | B | *}:PREPost?

Returned Format: :TRIGger{A | B}:PREPost {PREtrigger | POSTtrigger}

Name: **PREtrig**

Type: Command, Query

Function: This command is used to set the pre trigger percentage of the A or B trigger. The range is from 0 to 100% in 0.2% steps.

This query returns the current pre trigger percentage of the A or B trigger.

Command Syntax: :TRIGger{A | B | *}:PREtrig {numeric}

Example: :TRIGger{A}:PREtrig 50

Query syntax: :TRIGger{A | B | *}:PREtrig?

Returned Format: :TRIGger{A | B}:PREtrig {numeric}

See Also: PREPost

Name: **SLOpe**

Type: Command, Query

Function: This command is used to set the slope of the trigger used for the A or B trigger system. Plus means the positive (+) slope and minus means the negative (-) slope.

This query returns the current slope of the trigger used for the A or B trigger system.

Command Syntax: :TRIGger{A | B | *} :SLOpe{PLus | MINus}

Example: :TRIGger{A}:SLOpe PLus

Query syntax: :TRIGger{A | B | *}:SLOpe?

Returned Format: :TRIGger{A | B}:SLOpe{PLus | MINus}

Name: **SOurce**

Type: Command, Query

Function: This command is used to set the source for either the A or B trigger signals. The source can be any of the instrument's input channels, the external input (2 channel instrument only) or line. Note that channels 3 and 4 are only valid on a 4 channel instrument.

This query returns the source of the A or B trigger signals.

Command Syntax: :TRIGger{A | B | *}:SOurce {CHANnel1 | CHANnel2 | CHANnel 3 | CHANnel4 | LINE | EXT}

Example: :TRIGger{A}:SOurce LINE

Query syntax: :TRIGger{A | B | *}:SOurce?

Returned Format: :TRIGger{A | B}:SOurce {CHANnel1 | CHANnel2 | CHANnel 3 | CHANnel4 | LINE | EXT}

Name: **TVSyncpolarity**

Type: Command, Query

Function: This command is used to set the polarity of the sync pulses used by the TV trigger function.

This query returns the polarity of the sync pulses used by the TV trigger function. All three forms of this command have exactly the same effect.

Command Syntax: :TRIGger{A | B | *}: TVSyncpolarity {Positive | Negative}

Example: :TRIGger{A}: TVSyncpolarity Negative

Query syntax: :TRIGger{A | B | *}: TVSyncpolarity?

Returned Format: :TRIGger{A | B}: TVSyncpolarity {Positive | Negative}

Name: **TVtrigger**

Type: Command, Query

Function: This command is used to set the TV trigger type for the A or B trigger system. Frame is not available for B trigger.

This query returns the TV trigger type for the A or B trigger system.

Command Syntax: :TRIGger{A | B | *}:TVtrigger {LINE | FRAME | OFF}

Example: :TRIGger{A}:TVtriggerLINE

Query syntax: :TRIGger{A | B | *}:TVtrigger?

Returned Format: :TRIGger{A | B}:TVtrigger {LINE | FRAME | OFF}

6 Alphabetical Summary of Controls

A/Alt/B (27) Used to select which timebase controls the horizontal sweeps. This can be either the A timebase, the B timebase or alternately A and B. If ALT is selected all three indicators, A, B and ALT, are illuminated

Abort (53) Used to stop the plot sequence or restore local control from the GPIB bus.

ABS/Δ/Pos/Mag (6) Selects the cursor mode and the function of the datum paddles.
When cursor absolute mode, **ABS**, is selected the vertical datum is placed on trace ground and the horizontal measurements are made from the trigger point even if it is off screen.
Δ is illuminated when the cursor is set to delta mode. All measurements are then between the datum lines and the cursor as set by the user.
Mag allows the horizontal and vertical magnitude of a stored waveform to be varied using the **DATUM** keys (11) & (12).
Pos allows the trace that has the cursor placed on it to be shifted using the **DATUM** keys (11) & (12).

AC/Gnd/DC (33) Controls the type of coupling between the instrument and the input signal. **AC** is used to remove DC components from signals above 4Hz. **Gnd** internally disconnects the inputs from the instrument; a 0V reference signal is displayed instead. **DC** couples the input signal directly to the instrument, so that all frequency components of the signal will be displayed.

Add (24) & (26) Displays the sum (or difference if one channel is inverted) of the channels. The original traces disappear and the resultant trace is displayed as a new trace. There is a separate **Add** button for channels 1 & 2 and channels 3 & 4. When Add is selected the appropriate Add light is illuminated.

Armed (14) Illuminates after **S/shot** is pressed; it will stay lit until either a valid trigger has been received and a single sweep has been completed or the **Run** or **Auto Setup** button has been pressed.

Auto Setup (54) Will attempt to arrange the instrument so that a stable triggered display of the applied signal is obtained. If the frequency of the input signal is less than 20Hz, this function may not operate correctly.

Auto/Norm (43) Selects the trigger mode. **Norm** means that valid triggers must be received to initiate captures. **Auto** triggering is the same as **Norm** except that if no valid trigger has been received for 0.04s, an artificial 'A trigger' will be generated to initiate a capture. This is only true for A triggering. B triggering is always Norm.

Cal Pins A 1V, 1kHz square wave and a Ground reference are provided on these pins to enable probe compensation adjustments to be made.

Capture (4) Selects the Capture Master Menu. This menu is used to select and control some features that affect acquisitions. These are the 50Ω Select, the Probe Gain Select, the Bandwidth/Calibration, the Trigger Setup and the TV Trigger Menus and the Max/Min feature.

CH1/CH2/Ext/Line (48) Steps through the trigger sources. (2 channel instrument only).

CH1/CH2/CH3/CH4/Line (46) Steps through the trigger sources. (4 channel instrument only).

CH1 (49) One of the two or four channel input sockets, this one being for the connection of signals up to ± 400V peak to channel 1. It can also be a trigger source if selected using **CH1/CH2/Ext/Line** or **CH1/CH2/CH3/ CH4/Line**.

CH2 (42) One of the two or four channel input sockets, this one being for the connection of signals up to ± 400V peak to channel 2. It can also be a trigger source if selected using **CH1/CH2/Ext/Line** or **CH1/CH2/CH3/ CH4/Line**.

CH3 (37) One of the four channel input sockets, this one being for the connection of signals up to ± 400V peak to channel 3. It can also be a trigger source if selected using **CH1/CH2/CH3/ CH4/Line**.

CH4 (34) One of the four channel input sockets, this one being for the connection of signals up to ± 400V peak to channel 4. It can also be a trigger source if selected using **CH1/CH2/CH3/ CH4/Line**.

Control (47) This selects which of the A or B triggers and delays the Level (39) and Delay Paddles (38) control. **A** illuminates when the trigger controls are controlling the A trigger setup and **B** illuminates when the trigger controls are controlling B trigger setup.

CURSOR (10) Controls the left and right movement of the measurement cursor along the trace. This paddle can also used to select options in some menus.

DATUM (11) & (12) These two buttons control the movement of the time and voltage datum lines. If Mag or Pos is selected by the **ABS/Δ/Pos/Mag** button, these paddles then control the post storage manipulation of the trace.

Delay (38) This control varies the amount of Pre or Post trigger depending on the status of the Pre/Post switch (40)

Display (9) Selects the Display Master Menu. This menu is used to select and control features that affect the instrument's display. These are the Display Intensity and the Persistence Menus and Trace Dot Join.

Display (27) Selects either the A or B display for a particular input channel. **A** is illuminated when its channel is displaying the A timebase trace and **B** is illuminated when its channel is displaying the B timebase trace. Both **A** and **B** are illuminated when both timebases are displayed.

EXT TRIGGER socket (55) for the connection of external triggers of up to ±400V peak, fitted on the 2 channel instrument only.

F1 (50) This buttons is reserved for future expansion.

50Ω (35) Illuminates when the relevant channel's input impedance has been set to 50Ω from the menu system.

hf rej/AC/DC (46) selects trigger coupling. The **hf rej** (high frequency reject) option is a 15kHz low-pass filter. Any coupling may be used with any source except **Line** where the coupling is not selectable.

Hold (19) instantly freezes the entire display irrespective of the acquisition status. The Hold All light is illuminated when that display is held.

Hold (23) instantly freezes an individual channel's display irrespective of the acquisition status. The Hold On light is illuminated when that channel is held.

I/O (5) Selects the I/O Master Menu. This menu has features which are used to select and control data transfer and plot outputs. The menu items are Keyclicks, the Plot Configuration, RS423 plotter port and the GPIB or RS423 Menus and the Bulk Transfer and Radix selections.

Level (39) Adjusts the trigger level, which is indicated by two trigger bars on the display.

Math (2) This button selects the Math Master Menu. This menu provides access to sub-menus which affect acquisitions and manipulate and measure captured traces. These are the Persistence, Limits Testing and Averaging Menus, the Cursor Measurements, Trace Manipulation and Trace Math Menus.

Menu/Traces (3) Swaps the display between the last used menu and the trace display.

Numeric Keys (1) These keys are used in conjunction with the menu system to control the advanced features of the DSO. They are used for menu item selection and numeric entry.

Off/On/Inv (32) Switches the channel **On** or **Off**. If the channel is on its trace can be displayed **Inv**erted.

Plot (51) Initiates a plot output. The plot On light is illuminated during the plot sequence. Use the I/O menu to define the plot destination.

Position (22) Moves all traces horizontally relative to the graticule.

Position (25) Moves that channel's trace vertically relative to the graticule.

POWER (52) Used to switch the instrument on or off. When the instrument is turned on the Power On light is illuminated.

Pre/Post (40) Selects either Post Trigger Delay or Pre Trigger to be varied by the Delay paddle (38).

Refr/Roll/Pers (18) This button controls the instrument's data capture and display mode. In **Refr**esh the screen is updated from the left. In **Roll** the screen is updated from the right (chart recorder mode). In **Per**sistence mode successive acquisitions are added to the display to give a composite display of the signal variations.

Run (17) Puts the instrument in continuous capture mode; The instrument automatically rearms itself after each acquisition and updates the display continuously

S/Shot (15) Arms the instrument for a single-shot triggered acquisition sweep (capture). The **Armed** light (14) will be illuminated to show the status prior to a trigger event.

Save/Recall (8) Selects the Save/Recall Master Menu. This menu is used for the control and selection of the instrument memories for saving and recalling traces and setups. All the items are Sub-menus are the instrument Setups, the Ref Memory Save, the Ref Memory Recall, the Ref Trace Save the View Trace and the Set Time and Date Menus.

Select Trace (7) Places the cursor onto a displayed trace. Each successive press moves the cursor to the next available trace.

Stored (16) Illuminates on completion of a single-shot acquisition. It will stay lit until the instrument is rearmed or until **Run** is pressed.

TIME/DIV A (13) Controls the sweep rate of the A timebase. The timebase can be varied from 20ns/div to 50s/div.

TIME/DIV B (45) Controls the sweep rate of the B timebase. The timebase can be varied from 20ns/div to 50s/div but can only be set to be equal to or faster than the A timebase.

Trace Sep (36) In a dual timebase display mode this control allows the vertical separation of the A and B sweep traces to be varied.

Trig'd (44) This is illuminated -or flashes- when the relevant trigger system is receiving valid triggers.

Uncal (30) Controlled by the **VAR** button. It is lit when Uncal is selected.

Var (31) Toggles the relevant channel between Uncal and Cal. When Uncal is selected, the coarse setting of the vertical attenuator remains unchanged, but a continuously variable gain is available to the input signal. The **V/DIV** paddle is used to vary the additional attenuation throughout the range from ×1 to ×0.4.

V/DIV (29) Adjusts the vertical sensitivity over discrete calibrated ranges from 2mV/Div to 5V/Div in 1, 2, 5 steps. With a ×10 probe the ranges are 20mV/Div to 50V/Div at the probe tip. Input voltages to the instrument **must not exceed ±400V peak.** If the **Uncal** light is on, then this paddle controls the sensitivity over an uncalibrated continuous range of values.

X Mag (21) Used to select the horizontal magnification. The magnification factor is shown by the ×2, ×5 and ×10 lights.

X-Y (20) Takes the **CH1(X)** input as the X (horizontal) component and the other channel(s) as the Y (vertical component) of the displayed signal

+/- (41) Selects triggering on positive or negative slopes.

Appendix 1: Screen Messages

When something is wrong, an error message will be displayed inverse text near the bottom of the display. Also in some cases a message appears to confirm that an action has occurred. Brief explanation of when these messages occur are given below in alphabetical order:

** AUTO–SETUP **
: While the instrument is performing its Auto Setup routine.

50 OHM:NO AC COUPLING
: If channel AC coupling is selected when the channel impedance is 50Ω.

A TIMEBASE FORCED BY B
: If an attempt is made to set the B timebase range slower than the A timebase.

argument expected
: GPIB/RS423 The argument to a command or a query is missing.

A1

argument not known
: GPIB/RS423 does not recognize the argument to a command or query.

Auto Setup Aborted
: If Abort is pressed while the instrument is performing its Auto Setup routine.

AUTOSETUP ALREADY IN PROGRESS
: If AUTO SETUP is pressed during an autosetup.

AUTO–CALIBRATING
: While the instrument is performing its Auto calibration routine.

AVERAGING DISABLED IN ROLL
: If averaging is selected while the instrument is in roll mode.

B TIMEBASE FORCED BY A
: If an attempt is made to set the A timebase range faster than the B timebase.

B TRIG:NO AUTO TRIGGER
: If Auto mode is selected for the B trigger.

B TRIG:NOT IN USE
: If an attempt is made to change any of the B trigger settings when the B trigger is not in use.

Calibration Completed
: When an internal calibration is complete.

command failed
: A GPIB/RS423 command was not actioned correctly.

command not known
: GPIB/RS423, An unknown command was received.

command only
: A query form of an instruction that is only a command was received.

DATA CHECKSUM FAILURE
: Following a data transfer to the DSO if the checksum does not calculate correctly.

data expected
: GPIB/RS423, data was expected in the command but was not received.

data not expected
: GPIB/RS423, data was not expected in the command but was received.

DATUM LOCKED TO GND IN ABS MODE
: If an attempt is made to move the voltage datum when the cursor is in absolute mode.

excessive data
: GPIB/RS423, too much data was received.

GPIB dcas
: When the DSO has received and actioned a IEEE 488.2 Device Clear command.

GPIB deadlock
: A GPIB deadlock occurred because the DSO input and output queues were both full.

GPIB ifc
: When the DSO has received and actioned an IEEE 488.3 Interface Clear command.

GPIB interrupted
: A new program message was received before the entire response message had been read.

GPIB REMOTE
: When the DSO is in GPIB remote mode.

GPIB unterminated
: A response message was read before terminating the program message.

I/O OPTION POD FAULT
There is something wrong with the pod(s) fitted to the instrument.

I/O POD NOT FITTED
If the GPIB, RS423 or plotter port menu is selected without the appropriate pod fitted to the instrument.

illegal data
GPIB/RS423 Data received by the DSO is not allowed. e.g text where a number is expected.

input too long
GPIB/RS423 The command sequence received by the DSO is too long.

invalid mode
GPIB/RS423 If an attempt to set up an invalid mode is made.

invalid selection
GPIB/RS423 If an attempt is made to choose an invalid selection.

L.TEST AVAILABLE IN REFR ONLY
If limits test is selected and the instrument is not in refreshed mode.

LINE TRIG:AC hf–rej ONLY
If an attempt is made to set the coupling to anything other than AC hf–rej when the source is line.

LOCAL LOCKOUT
When the instrument is in local lockout mode.

MEMORY EMPTY
If the selected trace memory has not been used.

NO ADD WHEN HELD
If an attempt is made to add two channels and one or both of them are held.

NO AVERAGE IN ROLL
If an attempt is made to select averaging when the instrument is in Roll mode.

NO PLOTTER FITTED
This appears on the I/O Master Menu if a plotter is not fitted to the DSO.

NO ROLL IN DUAL TIMEBASE
If an attempt is made to select roll mode when both timebases are in use.

No valid input
If autosetup cannot find a suitable input.

NOT COMPATIBLE WITH BINARY MODE
If XON/XOFF handshake is selected when in binary mode.

PLOTTER FAULT
There is something wrong with the thermal plotter not covered by other messages.

PLOTTER HEAD RAISED
If an attempt is made to plot to the internal thermal plotter while its head is raised.

PLOTTER HOT – ALLOW TO COOL
If the internal thermal plotter gets too hot while it is plotting.

PLOTTER OUT OF PAPER
If an attempt is made to plot to the internal plotter and it runs out of paper.

POST STORAGE:ALREADY FILTERED
If an attempt is made to perform filtering on a trace that has already been filtered.

POST STORAGE:NO TRACE SELECTED
If a post storage operation is attempted without the cursor being placed on a trace.

POST STORAGE:RESULT OFF SCREEN
If the result of a post storage operation would position the trace off the screen.

POST STORAGE:TRACE NOT STORED
If a post storage operation is attempted on a trace that has not been stored.

PRESS AGAIN TO CONFIRM
If autosetup is pressed.

query only
GPIB/RS423 If a command form of an query only instruction is received.

REF TRACE EMPTY
If the selected reference trace memory has not been used.

ROLL:WILL MAGNIFY WHEN STORED
If X MAG is selected when the instrument is in roll mode.

RS423 REMOTE
When the Instrument is in RS423 Remote mode.

SETUP EMPTY
If the selected setup memory has not been used.

string expected
GPIB/RS423 Text enclosed by " " was expected but not received by the DSO.

TV TRIG:AC COUPLING ONLY
If trigger coupling is set to anything other than AC while TV trigger is selected.

TV TRIG:NO AUTO TRIGGER
If Auto trigger is selected when in TV trigger mode.

TV TRIG:SLOPE DISABLED
If an attempt is made to change the trigger slope when in TV trigger mode.

TV TRIG: NO LINE TRIG SOURCE
If Line is selected when in TV trigger mode.

WAITING FOR TRIGGER A THEN B
If S/shot has been selected but no A and or B trigger has been received.

WAITING FOR TRIGGER A
If S/shot has been selected but no trigger has been received.

WARNING:50Ω SELECT CONFIRM
If a setup to be recalled is selected which contains 50Ω.

WARNING INFINITE PERSISTENCE
If infinite persistence has been selected and S/Shot is pressed.

WARNING:3 TRACES ONLY/CH PAIR
If all 4 traces for a channel pair are turned on.

WARNING:CALC ALREADY SELECTED
If the same calculation is selected for more than 1 cursor measurement.

WARNING:NO Y TRACE VISIBLE
If XY mode is selected and only CH1 is turned on.

WARNING:VALUE FORCED INTO RANGE
GPIB/RS423 The argument was not an allowable value and was rounded to the nearest suitable number.

Appendix 2: Specification

Note: *Single channel mode refers to CH1 and CH3 or CH2 and CH4.*

Dual channel mode refers to all other combinations of input channels.

DISPLAY

CRT: 7 inch diagonal screen Raster scan, vertically scanned. Magnetically deflected.

Graticule: Electronically generated 8 × 10 divisions with 0.2 sub divisions.

Resolution: Time based display 501 × 256.

X-Y display 256 × 128.

Persistence display 256 × 128.

Intensity: Separate controls for Traces, Graticule, XY Display, B sweep bright up and Alphanumerics.

VERTICAL SYSTEM

Two or four identical channels, CH1, CH2, CH3 and CH4. Inputs via BNC connectors.

Sensitivity: 2mV/div to 5V/div in 1-2-5 sequence.

Accuracy: ≤± 2% ± 1 LSB with respect to graticule.

Variable Sensitivity: >2.5:1 range allowing continuous adjustment of sensitivity between ranges.

Input impedance: 1MΩ ± 2%//18pF or 50Ω ± 2%//18pF, menu selectable for each channel.

Input Coupling: 1MΩ: AC-GND-DC.
50Ω: GND-DC.

Bandwidth,Transient: DC: 0 - 100MHz (-3dB).
AC: 4Hz - 100MHz (-3dB).
Repetitive: DC: 0 - 100MHz (-3dB).
AC: 4Hz - 100MHz (-3dB).

Bandwidth Limit: 20MHz, menu selection common to all channels.

Maximum Input Voltage:

1MΩ: ±400V DC or peak AC to 10kHz or transient.
50Ω: 5V RMS.

Expansion: Post storage × 0.06 to × 4.

Vertical Position Range: ± 8 Divisions.

Probe Attenuation: Selection of ×1, ×10, ×100 and ×1000 for each channel to give measurements at the probe tip.

HORIZONTAL SYSTEM (A and B Timebases)

The DSO has two timebases which can operate alternately. Each can be set to operate from 20ns/div to 50s/div.

Horizontal Sweep Modes

Roll: A, B.
Refresh: A, A alt B, B.

Sweep Rate: 30 ranges.

Transient Capture:

610: 500ns/div to 50s/div. For both timebases with B faster or equal to A.

620: 125ns/div to 50s/div in single channel mode. 250ns/div to 50s/div in dual channel mode. For both timebases with B faster or equal to A.

Repetitive Sampling:

610: 20, 50, 100, 125 and 250ns/div using random ETS for both timebases with B faster than or equal to A.

620: 20, 50 and 100ns/div (also 125ns/div in dual channel mode) using random ETS for both timebases with B faster than or equal to A.

Sample Rate Accuracy: ±1% of unexpanded time/div ±700ps.

Expansion: ×2, ×5 and ×10 about center of screen of all traces with linear dot interpolation, to give a fastest displayed timebase speed of 2ns/div.

X Shift: End of unexpanded trace can be shifted to the center of screen.

TRIGGER DELAY

Trigger Delay Range: 0 to 999s on both timebases to a resolution of 5ns.

Trigger Delay Accuracy: ±0.01% of delay, ±0.1% of unexpanded timebase, ±700ps.

Resolution: 2% of time/div or 5ns whichever is larger.

Pre-Trigger: 0 to 100% of sweep in 0.2% steps for both A and B timebases.

TRIGGER SYSTEM (A and B Triggers)

There are two trigger systems, A and B. Each system has similar specifications.

Auto/Normal Mode: In Auto the timebase free runs when insufficient signal (20Hz to 150MHz) is present or when the selected level is outside the range of the input signal.

Source: 2 channel DSO: CH1, CH2, EXT, Line.
4 channel DSO: CH1, CH2, CH3, CH4, Line.

A2

Coupling: AC, DC, ACHFrej, DCHFrej, TV Field (A trigger only), TV Line.

Slope: +ve or -ve.

Sensitivity:

Internal DC coupled <0.3 div DC to 10MHz.
<1 div 10MHz to 150MHz.
AC coupled <0.3 div 10Hz to 10MHz.
<1 div 4Hz to 150MHz.

External (2 channel instrument only)
DC coupled <50mV DC to 10MHz.
<150mV 10MHz to 150MHz.
AC coupled <50mV 10Hz to 10MHz.
<150mV 4Hz to 150MHz.

Range: Variable over >12 divisions.

External input Impedance: 1MΩ ± 5%//≤ 18pf.

External Input Protection: ±400V DC or peak AC to 10kHz or transient.

Trigger Jitter: < ± 500ps.

Trigger Combinations: A & B timebases can be triggered independently or in any combination of the following:

A sweep from A trigger (after delay),
B sweep from A trigger (after delay),
B sweep from B trigger (after A trigger + delay).

A2

DISPLAY MODES

Refreshed: Stored data and display updated by triggered sweep. For timebases ≤1ms/div refresh operates as repetitive single shot.

Roll: Stored data and display scrolled from right, updated continuously for timebases 20ms/div to 50 sec/div. Trigger stops the updating process. For timebases faster than 20ms/div roll operates as repetitive single shot.

Persisted: Traces displayed as Refreshed above and also written to bit mapped display without trace clearing. User programmable 'n' sweeps or time held and displayed. For timebases ≤10ms/div, system operates as repetitive single shot at an update rate of 12 sweeps/sec.

Dot Join: Dots are joined by vertical raster lines. Linear dot interpolation is provided when the trace is X-expanded. Independent selection of persistence dot join.

X-Y: X-Y display is 8 × 8 divisions. Stored data and display are updated by triggered sweep. CH1 is used as the X and CH2, CH3 and CH4 are used as the Y deflection. X and Y display resolution is 7 bit (15 levels/div) and data resolution is 8 bit.

Single Trace: CH1 or CH2 or CH3 or CH4.

Multi Trace: Any combination of the available input channels can be used.

Add: CH1 + CH2 and/or CH3 + CH4.

Invert: Any of the available channels may be independently inverted.

Single Shot: Arms the instrument for a single triggered sweep and freezes the store at the end of the sweep.

Display Trace Hold (All): Freezes the display immediately. Persisted count is stopped.

Channel Trace Hold: Freezes individual channel immediately. Persisted count is stopped if all channels are held and will continue if any channel is released.

Third Trace Display: For each channel pair there is a third trace. This allows the display of selected channels at the second timebase, permitting simultaneous dual timebase display.

Trace Separation: The third trace can be separated from the original trace by ±4 div.

Reference Trace: any acquired trace can be replaced by a reference trace.

ACQUISITION SYSTEM

Bandwidth: 150MHz.

Maximum Sample Rate:
610: 100 megasamples/sec.
620: 400 megasamples/sec in 1 or 2 channel mode @ 125ns/div.
200 megasamples/sec in 3 or 4 channel mode @ 250ns/div.

Vertical Resolution: ±0.4% of full scale.

Record Length: 501 samples per channel.

ACQUISITION MODES

Normal Mode:

610: Transient and repetitive signal capture. Max transient capture timebase 500ns/div, 10ns/sample.

620: Transient and repetitive signal capture. Max transient capture timebase 125ns/div, 2.5ns/sample in single channel mode. 250ns/div, 5ns/sample in dual channel mode.

Repetitive Normal Mode: Maximum repetitive capture timebase 20ns/div, 400ps/sample in single and dual channel mode.

X-Y Mode: Bandwidth as acquisition channel. Acquisition rate dependent on timebase range to a maximum of 200MS/sec (100MS/sec on 610). Phase shift <3° DC-8MHz for fastest acquisition rate.

Averaging: Averages can be set from 2 to 256 in binary sequence, selected from menu system. Averaging operates continuously (weighted average) or, using single shot for the set number of acquisitions.

Peak Detection: (Glitch Capture) Capture of 2µs pulse width with 100% probability of capture.

MEMORY

Waveform Memory: Up to 16 traces can be archived in non-volatile memory and displayed, plotted etc. by recalling to the reference traces.

Set-Up: 8 control setups can be stored and recalled. These set-ups are retained during power down. These memories are non-volatile.

Retention Time: The memory support is trickle charged and will retain information for at least 3 months after power down.

ON SCREEN MEASUREMENTS and ALPHANUMERIC DISPLAY

Datum Lines: Horizontal and vertical full screen amplitude time and voltage datums.

Cursor: The measurement cursor can be assigned to a trace and measurements made in time and voltage with respect to the datums.

Cursor Measurement Display: ΔVoltage and ΔTime displayed on screen.

Accuracy:

Relative mode: Voltage ≤ ±2% of reading, ± 1 digitizing level ($^1/_{30}$ of a division).
Time ± 0.11% of unexpanded time/div ± 700ps.

Absolute mode: Voltage ≤ ±2% of FSD, ± 3 digitizing levels ($^1/_{30}$ of a division).
Time ± 0.21% of unexpanded time/div ± 1.6ns.

Resolution: Voltage 0.42% of F.S.D.
Time 0.2% of F.S.D.

Trigger Indication: On screen trigger level and trigger point indication.

Alphanumerics: Display on screen to indicate vertical sensitivity and invert status for each channel, Bandwidth limit, timebase speeds, pre-trigger or trigger delays. Arrow for off screen indication of trigger point and traces. While running long delays (> 3 sec) countdown time is shown.

CURSOR MEASUREMENTS

Top and Base

The Top and Base levels of a waveform, as defined by IEEE 181-1977, are measured between the time datum and the cursor.

Voltage and Time

The cursor measures the voltage and time relative to either the voltage and time datum lines or channel ground and the trigger point.

Voltage and 1/Time

The cursor measures the voltage and reciprocal of time relative to either the voltage and time datum lines or channel ground and the trigger point.

Peak-Peak

Calculates peak-to-peak voltage of the waveform bracketed between the time datum and cursor.

Max-Min

Displays maximum and minimum voltage excursions of a waveform relative to the voltage datum position. The cursor and datum bracket the waveform of interest.

Risetime (falltime)

Calculates the rise or fall time between the user defined percentage points of a signal; The 0% and 100% points are obtained by the Top & Base measurement.

Overshoot (preshoot)

Calculates the over or pre shoot of a signal as a percent of the 100% point as obtained by the Top & Base measurement.

Pulse Width

Calculates the time between user defined percentage points of a pulse, relative to the Top & Base 0 and 100% points, with the pulse being bracketed between the time datum and the cursor.

Frequency, Period, Duty Cycle

Calculates the average frequency, period and duty cycle of a waveform. Uses either the voltage datum as the zero crossing point or the mean of the waveform. The cursor and time datum set the limits of the area of interest.

RMS & AC RMS

Calculates the root mean square (RMS) voltage of a waveform bracketed between the cursor and time datum. The voltages are calculated with respect to both the voltage datum (DC-RMS) and the mean of the waveform (AC-RMS).

Area

Calculates the area under a waveform bracketed between the cursor and the voltage and time datum lines.

Trace Manipulation

Filter

6 selectable stages of low pass filter for each timebase range.

Invert

Inverts the trace about the voltage datum.

Integrate

Calculates the indefinite integral and displays the resultant waveform. A scaling factor of ×1, ×0.5, ×0.2 or ×0.1 can be applied to the integrated waveform.

Trace Arithmetic

Add

Adds any two traces and displays the result in a selected trace.

Subtract

Subtracts any two traces and displays the result in a selected trace.

Multiply

Multiplies any two traces and displays the result in a selected trace. A scaling factor of ×1, ×0.5, ×0.2 or ×0.1 can be applied to the multiplied waveform.

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Limits testing

Tests a waveform with respect to two definable limit waveforms and will display a TEST FAILED message if the acquired signal fall outside the limits. Acquisition can be continuous or stop-on-fail.

Persistence

Either the time, or number of acquisitions between screen clearances can be set to give a persisted trace display. Times of 0.5, 2, 5, 15, 30 or 90 seconds or multiple acquisitions of 10, 20, 50, 100, 200 or 500 traces can be selected. Both options can be set to infinity to give a permanent persistence display.

MENU SELECTION

Capture Master Menu: Selects menus for fast access to; Status, 50Ω selection, Trigger setup, TV trigger, Autocal, Probe gain, Max/min and Bandwidth selection.

Display Master Menu: Selects menus for fast access to; Trace arithmetic, screen controls, dot join, cursor, and averaging.

I/O Master Menu: Selects menus for fast access to; IEEE, RS423, plotter configuration, and Date and time.

Save/Recall Master Menu: Selects menus for fast access to; Instrument setup, Reference traces, Date and time, and Status.

Menu/Traces: Alternately switches between trace display and the last menu selection.

Math Master Menu : Selects menus for fast access to; Post storage manipulation and advanced measurement features.

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AUTO SETUP

Automatically sets the front panel controls to display any applied repetitive input signals for frequencies greater than 40Hz. Trigger and timebase priority is CH1 through to CH4.

I/O OPTIONS

The instrument can be fitted with either an IEEE-488 or a RS423 interface pod.

IEEE-488 I/O (optional pod)

Parallel data interface which permits all front panel controls except POWER On/Off to be programmed..

This pod also has an RS423 plotter output port.

Interface Capabilities: SH1, AH1, T5, L4, SR1, RL1, DC1, C0, E2, PP0 and DT0.

Data Rate: 50k bytes/sec burst.

Address: menu selectable 01 to 31.

RS423 I/O (optional pod)

Serial interface which permits all front panel controls except POWER On/Off to be programmed and is a bi-directional port for the transfer of binary trace data and associated range parameters. This pod also contains an RS423 plotter output port.

Baud Rate: 110, 300, 600, 1200, 2400, 4800, 9600.

Data Bits: 7 or 8.

Parity: Odd, even , mark, space or none.

Start/Stop: One start bit (fixed), one or two stop bits (selectable).

Handshake: XON/XOFF, CTS/RTS, Off.

Echo & prompt: On or Off.

DIGITAL PLOTTER INTERFACE

The instrument can directly output to suitable HPGL format plotters via the optional RS423 or IEEE interface port or to an internal, color or thermal, plotter if fitted .

Plot Mode: Manual or auto selection to output a stored trace.

Annotation: Range and scaling annotation, graticule, time and date information, cursors, cursor readout and measurement feature set output can all be included in the plot output.

Color: Colored pens automatically selected when available.

COLOR PLOTTER (optional)

Weight: Increases weight of DSO by 1.0kg (2.2lb).

Height: Increases height of DSO by 3mm.

Paper type: Part No. 04101165 (8 roll pack).

Paper length: 55 meters, equivalent to approximately 300 plots.

Pen type: Part No. 04101175 (4 color pack).

Pen life: Minimum of 250 meters line length approximately 175 plots.

THERMAL PLOTTER (optional)

Weight: Increases weight of DSO by 1.0kg (2.2lb).

Height: Increases height of DSO by 3mm.

Paper type: Part No. 04101251 (8 roll pack).

Paper length: 30 meters, equivalent to approximately 250 plots.

Print Head: Thermal dot line array, 640 dots per line.

REAL TIME CLOCK

24 hour time and date set via a menu. Printed out on plots to give a permanent record of acquisition time. The time and date is maintained for approximately ten years with the instrument's power disconnected.

ENVIRONMENTAL

Temperature: Operating 0° to +50°C.
Full specification + 15° to +35°C.
Storage -40° to +70°C.

Humidity: Operating IEC 68-2-Ca at 45°C with 95% RH.
Non-operating IEC 68-2-Db cycling 25°C to 45°C with 95% RH, 6 cycles (144 hours).

Vibration: MIL spec 810D. Random frequency vibrations of 5-500Hz at 1g rms for 15 minutes.
IEC 68-2-6 Test Fc. 15 cycles of 1 minute duration 10 to 55Hz at 0.6mm peak to peak displacement in each of the three major axis (4g at 55Hz).

Altitude: Operating 4600m.
Non-operating 15000m.

Safety: Designed for IEC 348 Cat 1 standard.

EMC: 4517/78 IEC TC64 WG4, 2kV spike in or out of line phase and 1/2 cycle dropout has no effect on instrument.

RFI: Conducted and radiated; to VDE 0871 level A, BS 6527 and US FCC part 15.

MISCELLANEOUS

Calibrator: 1V peak to peak ± 1%, frequency approximately 1kHz calibration signal on front panel.

Ground: Front panel ground reference.

POWER REQUIREMENTS

AC Voltage: 90 to 132V and 180 to 265V rms.

Frequency: 45 to 400Hz.

Power: 200W Maximum

WEIGHT

2 channel: 12kg (26lb) approx.
4 channel: 13kg (29lb) approx.

DIMENSIONS

145mm height × 305mm width × 360mm depth ($5\frac{3}{4} \times 12 \times 14\frac{1}{8}$ inches) excluding handle

ACCESSORIES SUPPLIED

Operating Manual
Line Cord
2 channel: 2 probes
4 channel: 4 probes

OPTIONAL ACCESSORIES

Rack mounting kit
Carrying case
Front facia cover
Service manual

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Appendix 3 Glossary of terms

Alias
A false image caused when the signal is very much faster than the sample rate see section 1.6.2.

An effect that occurs when an analog signal is sampled digitally at a sampling frequency less than twice the signal frequency: a signal is retrieved from the sample information that differs from the original input signal.

ANSI
American National Standards Institute.

BSI
British Standards Institute.

CMRR
Common Mode Rejection Ratio. The measure by which the ability of the instrument to ignore signals common to both the signal input and ground terminals is determined.

$$20 \text{ Log}_{10} \frac{\text{Displayed signal on screen}}{\text{Signal on common}}$$

CRT
Cathode Ray Tube. The display device in the DSO.

Data points
The individual samples of the input waveform.

DSO
Digital Storage Oscilloscope.

ETS
For repetitive signals which require multiple sweeps, samples are taken at random, varying, times relative to the trigger point to eventually capture the entire input waveform. This technique extends the useful operating frequency of a DSO from its single sweep sampling limit.

IEE
Institution of Electrical Engineers.

IEEE
Institute of Electrical and Electronics Engineers, Inc.

GPIB
General Purpose Interface Bus. Another more common name for the IEEE-488 interface bus defined by ANSI/IEEE Standard 488-1978.

Sampling theorem
This states that if an input signal contains no frequency components higher than f, the signal can be captured and displayed without distortion if it is sampled at a rate greater than $2f$. f is referred to as the Nyquist Frequency.

Real Time Sampling
Used for single sweep acquisitions. The signal is sampled so that all the data points are acquired at equal time intervals sequentially from the start to finish of a single sweep.

RS423
Interface standard set by the Electronic Industries Association (EIA).

Sample Rate
The rate at which the instrument records the signal levels of the input waveform to produce the data points.

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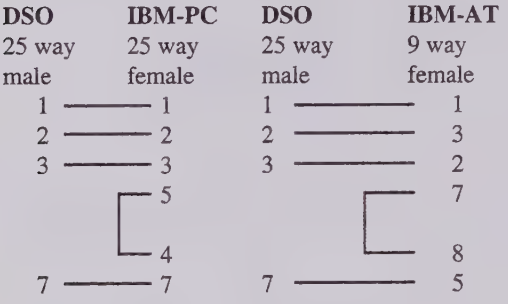
APPENDIX 4

Interfacing the DSO to an IBM-PC via the RS423 (RS232)

There are a number of points worth noting when interfacing the DSO to an IBM-PC or AT via the RS423 port.

1. There are two ports on the RS423 module.
   Port 1 (the top one) is the bi-directional control interface for use with a computer.
   Port 2 (the bottom one) is an output only interface for use with an HPGL plotter.

2. The cable should be wired as follows:



   This bypasses the RTS-CTS handshaking. For large data blocks XON-XOFF handshaking can be used.

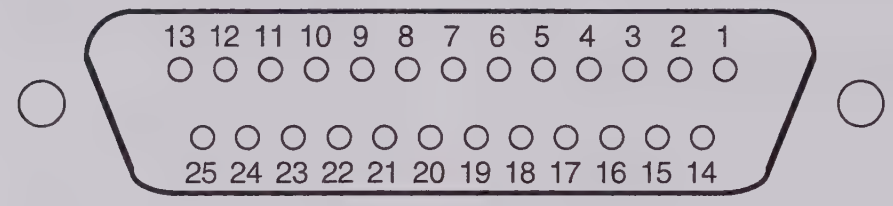
3. In most cases Echo should be OFF
   This is only for use with dumb terminals, and echoes back every character as it is received. This is unnecessary when using a PC as a controller, and can cause problems if the software is not expecting to receive the echoed characters.

4. To test the interface and connections the following short BASIC program can be run:

```
10OPEN "COM1:9600,N,8,1,DS0,LF" AS #1
20PRINT #1,"CHAN1:COUPLING?"
30INPUT #1,X$
40PRINT X$
50CLOSE #1
```

   This uses the COM1 port on the IBM, and sets up the interface to 9600 baud, no parity, 8 data bits, 1 stop bit, no DSR-DTR handshaking and Line Feed as a terminator. The program then requests the vertical coupling of channel 1, inputs the response from the DSO, and prints it on the screen. For example if channel 1 is AC coupled the program should print CHAN1:COUPLING AC, and leave the instrument in RS423 Remote Mode.

Appendix 5: Connector Pinouts

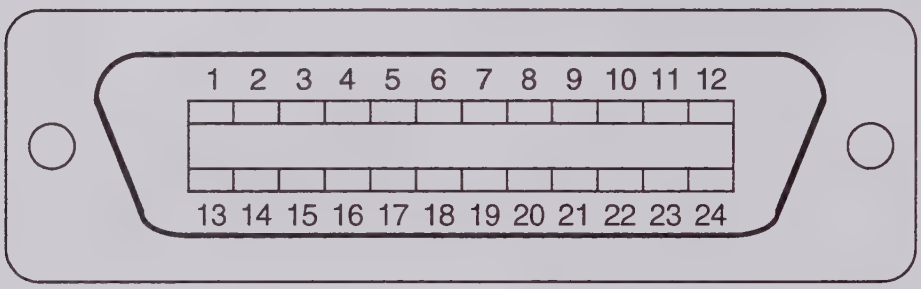


Pin	Signal	Description
1	0V	Protective Ground
2	RXD	Receive Data
3	TXD	Transmit Data
4	CTS	Clear to Send
5	RTS	Request to Send
7	0V	Signal Ground

Figure A5a RS423 Port Connector Pinout

Pin	Signal	Description
1	0V	Protective Ground
2	RXD	Receive Data
3	TXD	Transmit Data
6	DSR	Data Send Ready
7	0V	Signal Ground
20	DTR	Data Terminal Ready

Figure A5b RS423 Plotter Port Connector Pinout



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Pin	Signal	Description	Pin	Signal	Description
1	DIO1	Data input output line 1	13	DIO5	Data input output line 5
2	DIO2	Data input output line 2	14	DIO6	Data input output line 6
3	DIO3	Data input output line 3	15	DIO7	Data input output line 7
4	DIO4	Data input output line 4	16	DIO8	Data input output line 8
5	EOI	End Or Identify	17	REN	Remote Enable
6	DAV	Data Valid	18	(DAV)	Return line
7	NRFD	Not ready for data	19	(NRFD)	Return line
8	NDAC	Data not accepted	20	(NDAC)	Return line
9	IFC	Interface Clear	21	(IFC)	Return line
10	SRQ	Service Request	22	(SRQ)	Return line
11	ATN	Attention	23	(ATN)	Return line
12	Shield		24	Logic Ground	

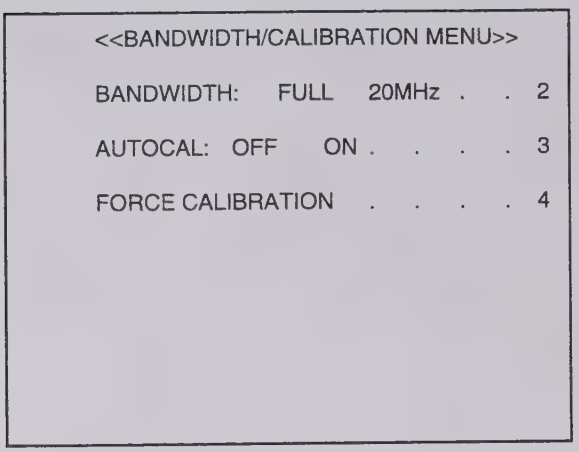
Figure A5b GPIB Connector Pinout

Appendix 6: Front Panel and Menu GPIB Equivalents

<<CAPTURE MASTER MENU>>	:MENU :CAPtureMastermenu
50Ω SELECT MENU 2	:MENU :50OHMselectmenu
PROBE GAIN SELECT MENU 3	:MENU :PROBeGainselectionmenu
BANDWIDTH/CALIBRATION MENU . . 4	:MENU :BANDWidth&calibrationmenu
TRIGGER SETUP MENU 5	:MENU :TRIGgerSetupmenu
TV TRIGGER MENU 6	:MENU :TVTriggermenu
MAX/MIN: OFF ON 7	:ACQuisition :MAXmin
STATUS 8	:MENU :CURrentStatus

<<50Ω SELECT MENU>>	:MENU :50OHMselectmenu
CH1: 50Ω 1MΩ 3	:CHANnel1 :TERM50
CH2: 50Ω 1MΩ 4	:CHANnel2 :TERM50
CH3: 50Ω 1MΩ 5	:CHANnel3 :TERM50
CH4: 50Ω 1MΩ 6	:CHANnel4 :TERM50
50Ω 5V R.M.S. Max	

<<PROBE GAIN SELECT MENU>>	:MENU :PROBeGainselectionmenu
CH1: x1 x10 x100 x1000 . . 3	:CHANnel1 :PRObe
CH2: x1 x10 x100 x1000 . . 4	:CHANnel2 :PRObe
CH3: x1 x10 x100 x1000 . . 5	:CHANnel3:PRObe
CH4: x1 x10 x100 x1000 . . 6	:CHANnel4 :PRObe

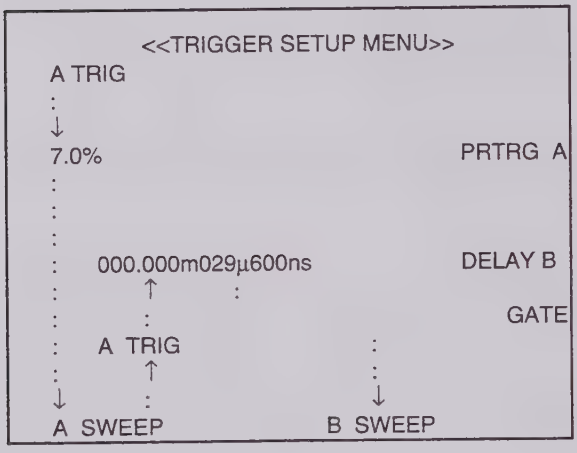


:MENU :BANDWidth&calibrationmenu

:BANDWidthLimit

:CALibrate :ENable

:CALibrate :FORce

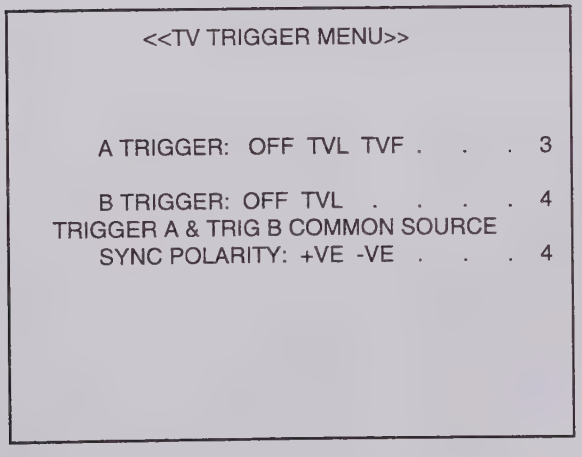


:MENU :TRIGgerSetupmenu

:TRIGgerA :PREtrig

:TRIGgerB :DELay

:TRIGger :AGAteb



:MENU :TVTriggermenu

:TRIGGERA :TVtrigger

:TRIGGERB :TVtrigger

:TRIGGER{ A | B } :TVSyncpolarity

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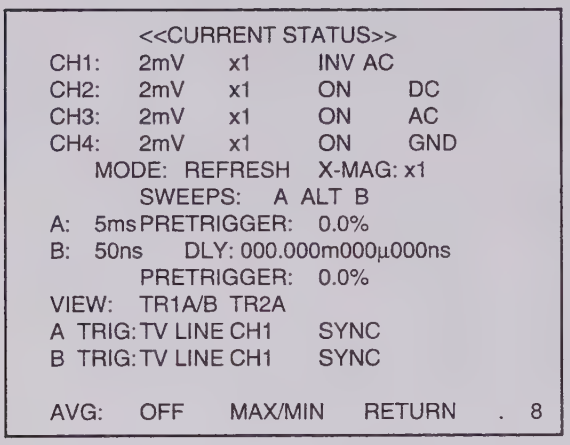
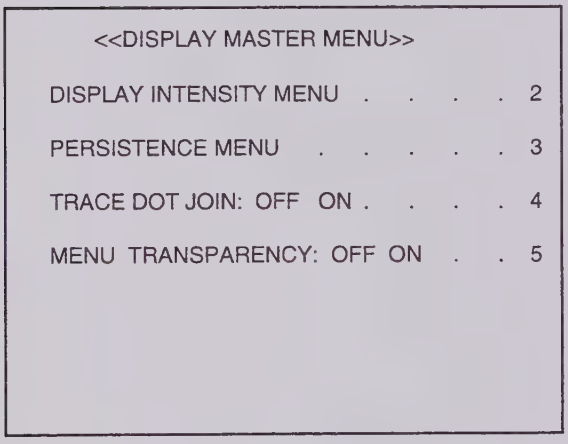

<<CURRENT STATUS>>
CH1: 2mV x1 INV AC
CH2: 2mV x1 ON DC
CH3: 2mV x1 ON AC
CH4: 2mV x1 ON GND
MODE: REFRESH X-MAG: x1
SWEEPS: A ALT B
A: 5ms PRETRIGGER: 0.0%
B: 50ns DLY: 000.000m000µ000ns
PRETRIGGER: 0.0%
VIEW: TR1A/B TR2A
A TRIG: TV LINE CH1 SYNC
B TRIG: TV LINE CH1 SYNC
AVG: OFF MAX/MIN RETURN . 8

:MENU :CurrentStatus



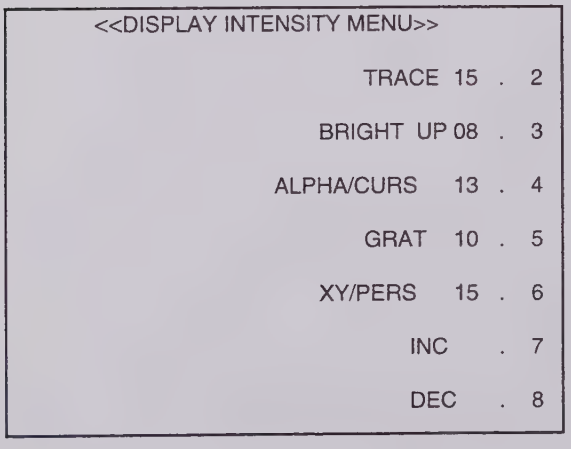
:MENU :DISPlayMastermenu

:MENU :DISPlayIntensitymenu

:MENU :PERSistencemenu

:DISPlay :TRACEDotjoin

:MENU :TRANSparency



:MENU :DISPlayIntensitymenu

:DISPlay: TRACEBrightness

:DISPlay: BRIGhtupcontrast

:DISPlay: ALPHABrightness

:DISPlay: GRATBrightness

:DISPlay: XYPERSBrightness

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<<PERSISTENCE MENU>>	
PERSISTENCE: TIME CYCLES . . 2	:MENU :PERSistencemenu :DISPlay :PERSMode
PERSISTENCE TIME: 0.5 2.0 5.0 15 30 90 ∞ . . 4	:DISPlay :PERSTime
PERSISTENCE CYCLES: 10 20 50 100 200 500 ∞. . 6	:DISPlay :PERSCycles
PERSISTENCE DOT JOIN: OFF ON . . 7	:DISPlay :PERSDotjoin

<<I/O MASTER MENU>>	
KEYCLICKS: OFF ON 2	:MENU :I/OMastermenu :KEYclick
PLOT CONFIGURATION MENU . . . 3	:MENU :PLOTconfigurationmenu
RS423 CONTROL PORT MENU . . . 4	:MENU :RS423Controlportmenu
GPIB MENU 5	:MENU :GPIBmenu
BULK TRANSFER: BIN TEXT . . . 6	:TRANsfer :FORMat
RADIX: OCT DEC HEX . . 7	:TRANsfer :RADIX

<<PLOT CONFIGURATION MENU>>	
PLOT MODE: AUTO SINGLE . . 2	:MENU :PLOTconfigurationmenu :PLOT :MOde
TO: INTERNAL GPIB RS423 . . 3	:PLOT :DEst
LABELS, DATES & CURSORS: OFF ON . 4	:PLOT :LABELsdatecursor
GRAT: OFF ON 5	:PLOT :GRaticule
PERSIST: OFF SOLID BROKEN . 6	:PLOT :PERStype
LIMITS: OFF LINE FILLED 7	
CHANGE PEN 8	:PLOT :PEnchange

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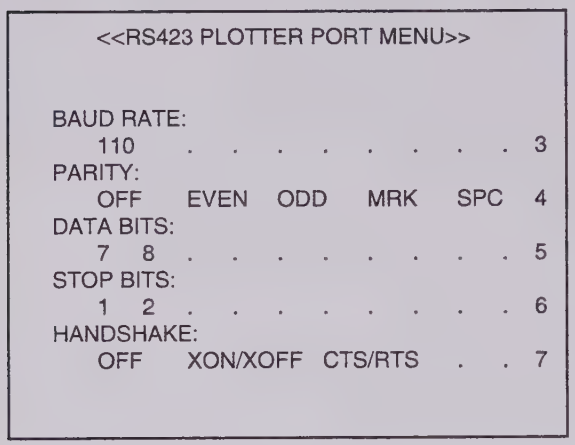


:MENU :RS423Plotterportmenu

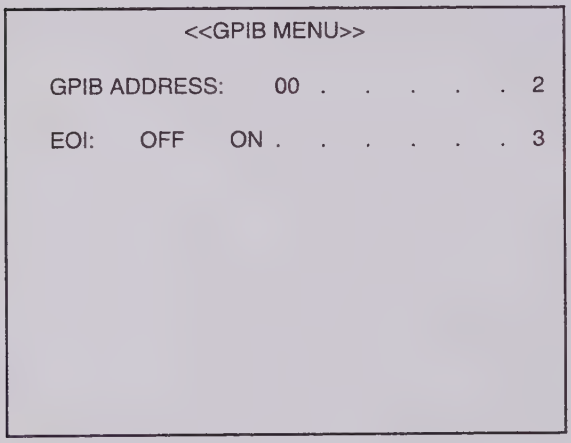
:PLOT :BAUD

:PLOT :PARity

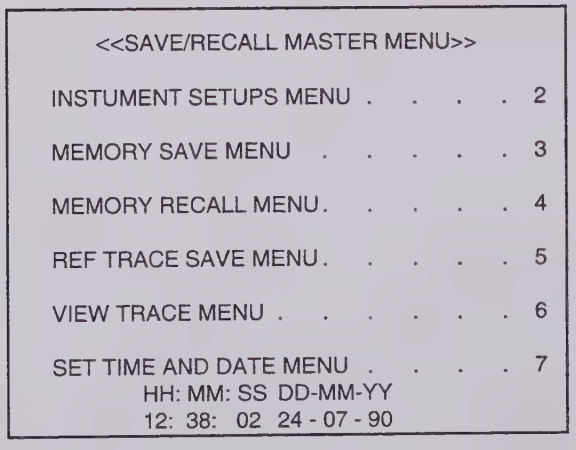
:PLOT :BPC

:PLOT :STopBits

:PLOT :HAnd



:MENU :GPIBmenu



:MENU :SaveandRecallMastermenu

:MENU :INSTrumentSetupsmenu

:MENU :MEMorySavemenu

:MENU :MEMoryRecallmenu

:MENU :REFTraceSavemenu

:MENU :VIEWTracemenu

:MENU :setTimeandDatemenu

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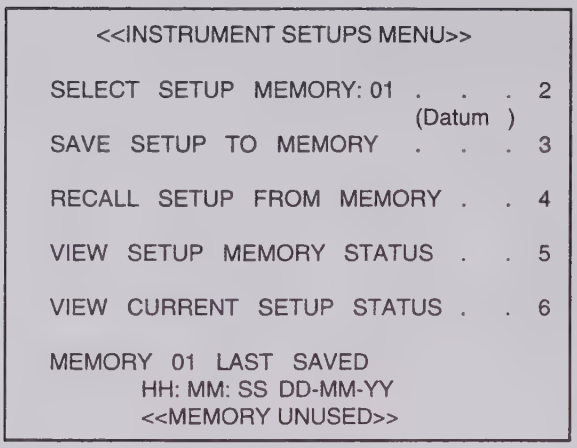
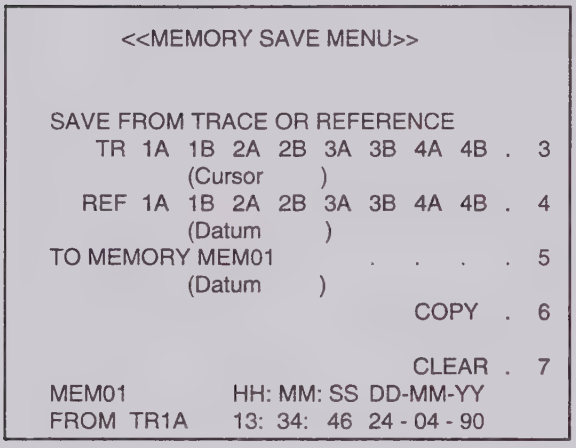


:MENU :INSTrumentSetupsmenu

:SETup :SAVE

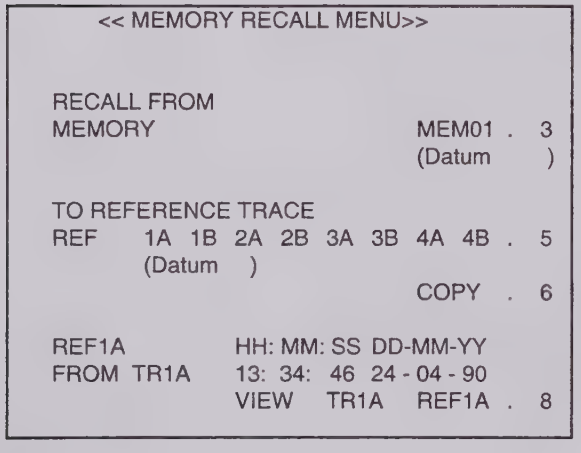
:SETup :RECALL



:MENU :MEMorySavemenu

:MEMory :SAVE

:MEMory :CLear



:MENU :MEMoryRecallmenu

:MEMory :RECALL

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```
<<REF TRACE SAVE MENU>>

SAVE FROM TRACE OR REFERENCE
    1A  1B  2A  2B  3A  3B  4A  4B ALL .  3
        (Cursor      )

TO REFERENCE TRACE
    1A  1B  2A  2B  3A  3B  4A  4B  .   .  5
        (Datum       )
                              COPY  .  6

MEM01          HH: MM: SS DD-MM-YY
FROM TR1A      13: 34:  46 24 - 04 - 90
                       TRACE 2B OFF  .  8
```

:MENU :REFTraceSavemenu

:REFerenceTRace :SAVE

VIEW TRACE	CHANNEL 1 OFF 1	:DISPLAY :TRace
	CHANNEL 1 OFF 2	:DISPLAY :TRace
	TR2A REF2A . . 3	:DISPLAY :TRace
	TRACE 2B OFF . 4	:DISPLAY :TRace
	TR3A REF3A . . 5	:DISPLAY :TRace
	TRACE 3B OFF . 6	:DISPLAY :TRace
	CHANNEL 4 OFF 7	:DISPLAY :TRace
	CHANNEL 4 OFF 8	:DISPLAY :TRace

```
<<SET TIME AND DATE MENU>>

                          SET CLOCK .  2


              HH: MM: SS
TIME          12: 32: 06 .  .  .  .  .  4

              DD-MM-YY
DATE          24 - 07 - 90 .  .  .  .  .  6

FORMAT: MM-DD-YY DD-MM-YY     .  .  7

+/- 30 SECOND ADJUSTMENT      .  .  .  8
```

:MENU :setTimeandDatemenu

:TIME

:DATE

:DATE :FORMAT

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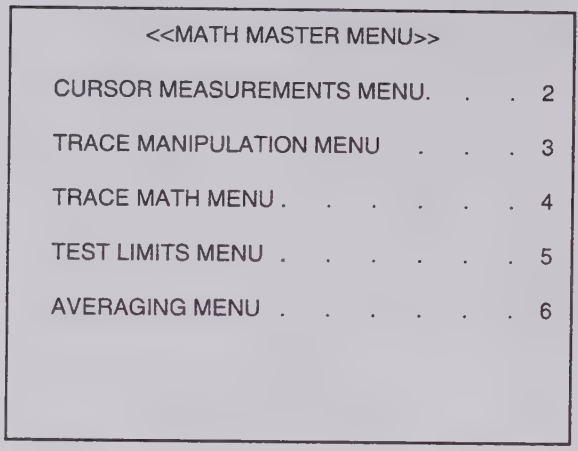


:MENU :MATHMastermenu

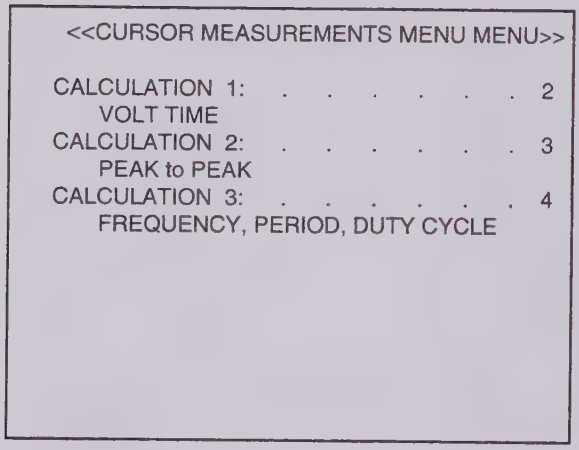
:MENU :CURSorMeasurementsmenu

:MENU :TRACeMANIPulationmenu

:MENU :TRACeMATHmenu

:MENU :LIMitsTestmenu

:MENU :AVeraGingmenu

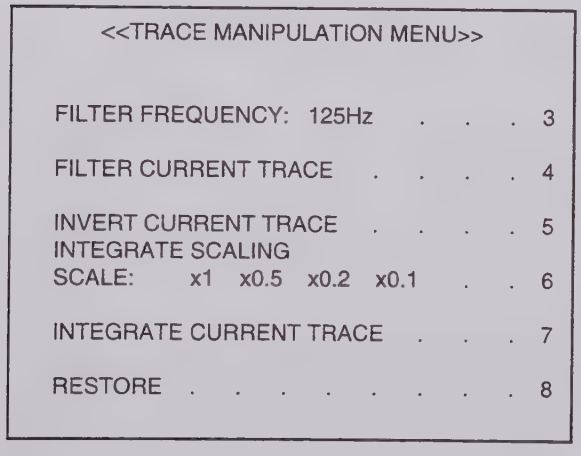


:MENU :CURSorMeasurementsmenu

:CURSor :CALCulation1

:CURSor :CALCulation2

:CURSor :CALCulation3



:MENU :TRACeMANIPulationmenu

:POSTStore :FILterFACtor

:POSTStore :FILter

:POSTStore :INVert

:POSTStore :INTegrateScaling

:POSTStore :INTegrate

:POSTStore :REStore

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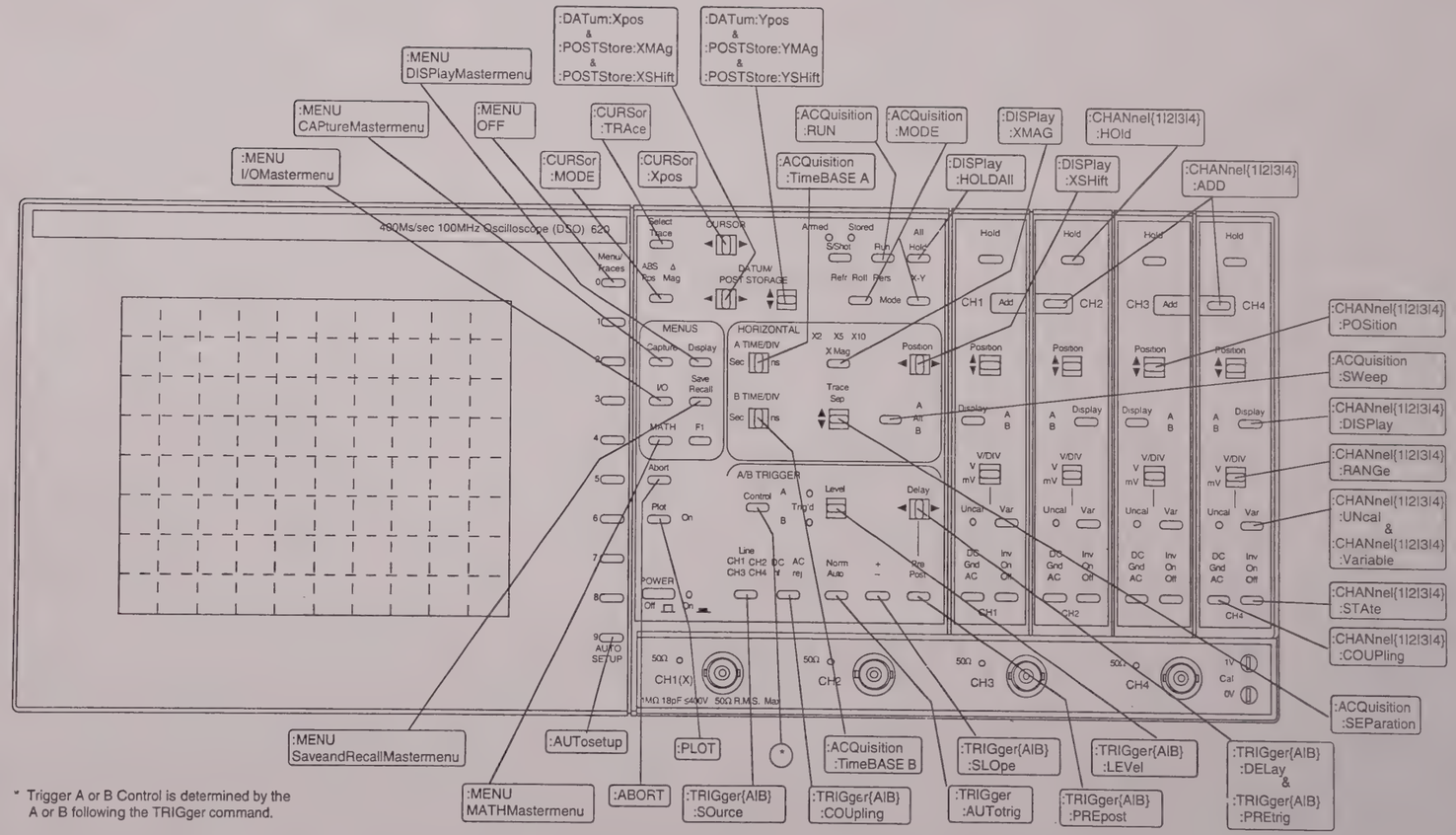
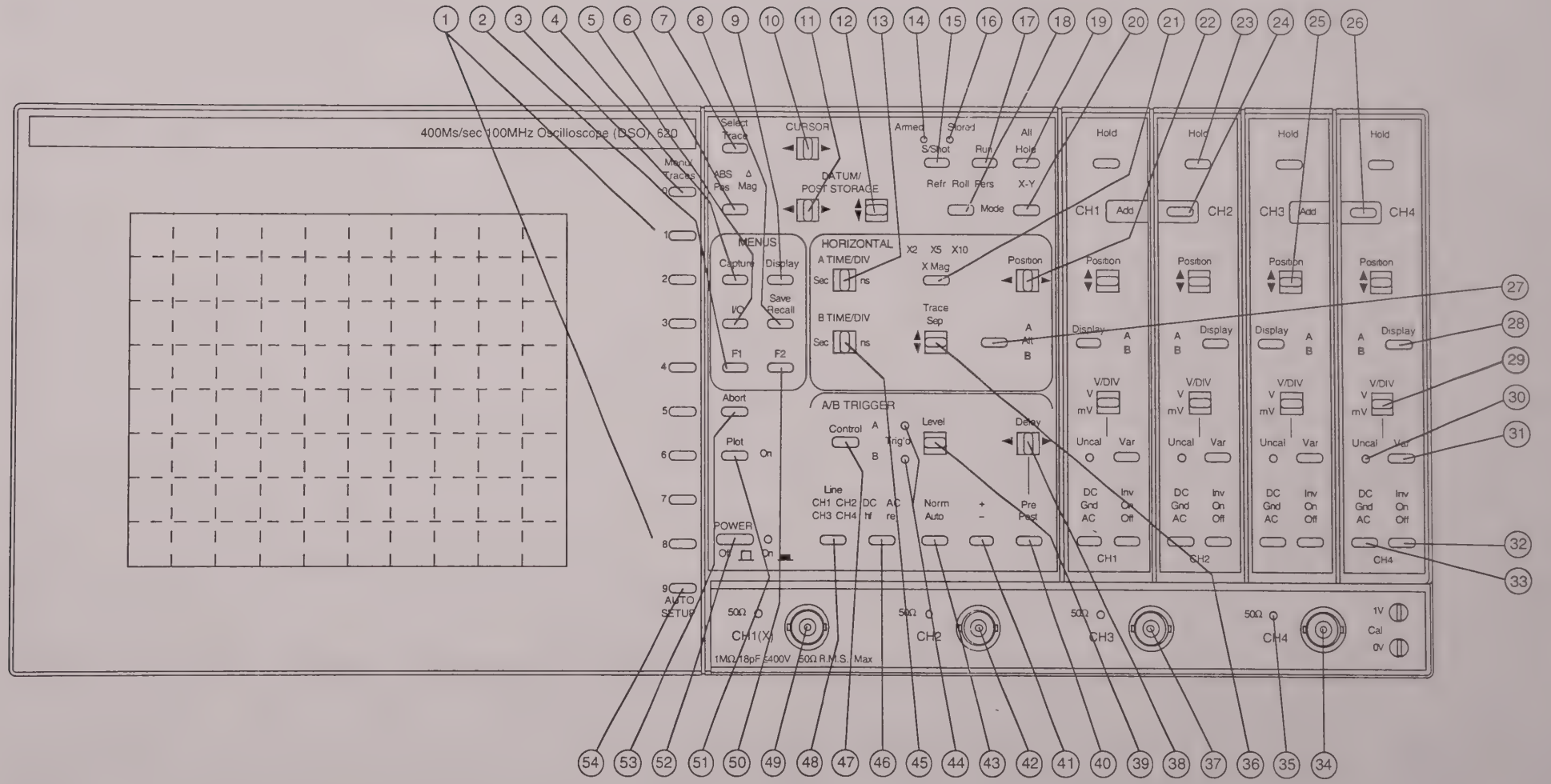
<<TRACE MATH MENU>>		
TR1A	SOURCE 1 . . 2	:MENU :TRACeMATHmenu
+ - x	OPERATION . . 3	:ARITHmetic : Source1
TR2A	SOURCE 1 . . 4	:ARITHmetic : FUnction
RESULT TO	= TR3A . . . 5	:ARITHmetic : Source2
SCALE: x1 x0.5 x0.2 x0.1	. . 6	:ARITHmetic : DESTination
EXECUTE OPERATION	. 7	:ARITHmetic : MULTScaling
		:ARITHmetic : EXEcute

<<LIMITS TESTING MENU>>	
SET UPPER LIMIT 2	:MENU :LIMitsTestmenu
SET LOWER LIMIT 3	:LIMits :UPper
TEST LIMITS: OFF ON STOP-ON-FAIL . 5	:LIMits :LOWer
DISPLAY LIMITS: OFF ON . . . 6	:LIMits :MODE
	:LIMits :DISPlay

<<AVERAGING MENU>>	
AVERAGING: OFF ON 2	:MENU :AVeraGingmenu
AVERAGE VALUE: 2 4 8 16 32 64 128 256. . 4	:ACQuisition :AVeraGe :ENable
	:ACQuisition :AVeraGe :FACTor



* Trigger A or B Control is determined by the A or B following the TRIGger command.


400Ms/sec 100MHz Oscilloscope (DSO) 620
Select Trace
CURSOR
Armed
Stored
All Holds
S/Shot
Run
Refr
Roll
Pers
X-Y
Mode
DATUM/ POST STORAGE
Menu Traces
ABS Pos
Δ Mag
MENUS
Capture
Display
I/O
Save Recall
F1
F2
HORIZONTAL
A TIME/DIV
Sec
ns
X2
X5
X10
X Mag
Position
B TIME/DIV
Trace Sep
A Alt B
Abort
Plot
On
A/B TRIGGER
Control
A
B
Trig'd
Level
Delay
Line
CH1 CH2 CH3 CH4
DC
AC
hf
re
Norm
Auto
+
–
Pre
Post
POWER
Off
On
AUTO SETUP
Hold
CH1
Add
CH2
CH3
CH4
Display
A
B
V/DIV
V
mV
Uncal
Var
DC
Gnd
AC
Inv
On
Off
50Ω
CH1(X)
1MΩ,18pF ≤400V
50Ω R.M.S. Max
CH2
CH3
CH4
1V
Cal
0V

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Manual Part Number 431070

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